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ABSTRACT

This manual and the accompanying software are intended to provide a step-by-step guide to conducting a meta-analytic study along with references for further reading and free high-quality software, "Meta-Stat." "Meta-Stat" is a comprehensive package designed to help in the meta-analysis of research studies in the social and behavioral sciences. Features include: (1) an effect size calculator; (2) corrected regression outputs; (3) homogeneity statistics; (4) variance ratio; and (5) fail-safe "N." This manual discusses effect-size meta-analysis, but "Meta-Stat" also offers correlational meta-analysis, and the plain statistics module can be used to analyze regular data not for meta analysis. The chapters are: (1) "Introducing 'Meta-Stat' and Meta-Analysis"; (2) "Installing and Setting Up 'Meta-Stat'" (3) "Setting Up a Meta-Analysis"; (4) "Managing Files"; (5) "Working with Variables"; (6) "Entering Study Data"; (7) "Applying Statistical Techniques"; (8) "Charting Data"; and (9) "Technical Information." Multiple illustrations present "Meta-Stat" screens. (Contains 123 references.) (SLD)

A User's Guide to the Meta-Analysis of Research Studies

$$d = \overline{D}\frac{\sqrt{N}}{t}$$

Meta-Stat:
Software to aid in the meta-analysis of research findings

Lawrence M. Rudner
Gene V Glass
David L. Evartt
Patrick J. Emery

$$r = \sqrt{z^2 / N}$$

Educational Resources Information Center
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***Meta-Stat* Software**

Through the ERIC Clearinghouse on Assessment and Evaluation, we are making the software and manual available free on the internet for non-commercial, educational and research purposes. Should you prepare a report or paper based on the use of this software, we require that you acknowledge ***Meta-Stat*** in your report or paper.

Meta-Stat was written in Turbo Pascal 7.0 by Borland International and it incorporates the following toolboxes: Scientific and Engineering Tools by Quinn-Curtis; Turbo Toolkit by Technojock Software; BGI Driver Toolkit by Ryle Design; and PCX Toolkit by Genus Microprogramming.

Preface

Welcome to this introduction to meta-analysis

Meta-analysis refers to the analysis of analyses...the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings (Glass, 1976, p. 3).

This book and accompanying software are intended to help you learn more about meta-analysis by providing you with a step-by-step guide to conducting a meta-analytic study, references for further research and reading, and free, high-quality software.

Gene Glass first used the term "meta-analysis" in 1976 in his presidential address to the American Educational Research Association to refer to a philosophy, not a statistical technique. Glass argued that literature review should be as systematic as primary research and should interpret the results of individual studies in the context of distributions of findings, partially determined by study characteristics and partially random. Since that time, meta-analysis has become a widely accepted research tool, encompassing a family of procedures used in a variety of disciplines.

Meta-analysis responds to several problems in educational research. First, important issues are studied by numerous investigators. The amount of information on a given topic therefore is often overwhelming and not amenable to summary. Even when there are relatively few studies on a given topic, it is difficult to determine if outcome differences are attributable to chance, to methodological inadequacies, or to systematic differences in study characteristics. Informal methods of narrative review permit biases to remain easily undetected. Reviewers' biases can influence decisions about study inclusion, relative weights given to different findings, and analysis of relations between study features and outcomes. These biases can have clandestine effects when reviewers do not systematically seek to reduce them or provide sufficient information for readers to evaluate their extent.

Meta-analysis typically follows the same steps as primary research. The meta-analyst first defines the review's purpose. Organizing frameworks can be practical or theoretical questions of varying scope, but they must be clear enough to guide study selection and data collection. Second, sample selection consists of applying specified procedures for locating studies that meet specified criteria for inclusion. Typically, meta-analyses are comprehensive reviews of the full population of relevant studies. Third, data are collected from studies in two ways. Study features are coded according to the objectives of the review and as checks on threats to validity. Study outcomes are transformed to a common metric so that they can be compared. A typical metric in educational research is the effect size, the standardized difference between treatment and control group means. Finally, statistical procedures are used to investigate relations among study characteristics and findings.

The accompanying software, ***Meta-Stat,***is a comprehensive package designed to help in the meta-analysis of research studies in the social and behavioral sciences. Meta-analysis in the traditions of Glass, Hedges and Olkin, and Schmidt and Hunter are offered. Features include:

- an effect-size calculator to help convert from reported metrics to effect-size
- Corrected regression outputs
- Homogeneity statistics
- Variance ratio
- Fail-safe N.

The system provides you with routines for easy data entry, statistical analysis, and graphic analysis. The data can easily be output in ASCII format or in a format ready for use by the Statistical Package for the Social Sciences (SPSS).

Throughout this manual we discuss effect-size meta-analysis. Yet, ***Meta-Stat*** also offers correlational meta-analysis. With our easy graphic routines, you may want to use our Plain-Statistics module for analyzing regular, non-meta-analytic data.

Meta-Stat has been under development for a number of years. A prototype was developed in 1989 with Phase I Small Business Innovative Research (SBIR) funding from the National Institutes of Health. We were able to demonstrate that the system had potential and two years latter we were able to secure Phase II SBIR funding. In late 1993, the first commercial system was ready.

Programming for ***Meta-Stat*** was conducted by Lawrence M. Rudner, David L. Evartt, and Patrick J. Emery. This manual was prepared by Lawrence Rudner and Dana Sohr of Technical Communications, Inc. in Fulton, Maryland with the assistance of Gerald Bracey, Gene Glass, Caroline Bagin, David Evartt, and Pamela Getson.

The system has been through two field trials. Our field testers caught numerous mistakes, incorrect formulas, bugs, and the like. We gratefully acknowledge *David Gibson*, Science Applications Inc; *Robert Bangert-Drowns*, State University at Albany; *Philip C. Abrami* Concordia University; *Michael J. Strube*, Washington University; *James A. Kulik*, University of Michigan; *Chen-Lin C. Kulik*, University of Michigan; *Roger E. Millsap*, City University of New York; *Michael R. Stevensen* Ball State University; *Herbert C. Rudman*, Michigan State University; *Peter A. Cohen,* Medical College of Georgia; *Norman Miller*, University of Southern California; *Karl White,* Utah State University; *Larry Leslie,* University of Arizona; and *Arthur L. White,* Ohio State University for their assistance with one or both of the field tests.

We are especially indebted to Professor Gene V Glass. Gene has been a consultant to this project since its inception. Aside from moral support, he provided a large investment of time. He provided a comprehensive testing of the system catching errors such as the use of 1.96 rather than the appropriate value of the t-statistic, suggested different ways to present information on the screens, suggested new features, helped edit the manual (he was very picky and he caught numerous errors) and most importantly reacted to ideas and answered questions. We were often in daily communication.

I hope you find this book and ***Meta-Stat*** useful in your work and as a teaching and learning tool.

-- Lawrence M. Rudner

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1 Introducing Meta-Analysis and *Meta-Stat*

This chapter introduces meta-analysis and the ***Meta-Stat*** program.

Introducing Meta-Analysis

Research literature, it is often pointed out, is growing at an exponential rate. A recent study estimated that there are 40,000 journals for the sciences, and that researchers are filling those journals at the rate of one article every 30 seconds, 24 hours a day, seven days a week (Mahoney, 1985). No matter what the topic—from computer-aided instruction to sex differences to the effects of medication on hyperactivity—researchers can, in just a few years, add dozens and even hundreds of studies to the literature.

As research results accumulate, it becomes increasingly difficult to understand what they tell us. It becomes increasingly difficult to find the knowledge in this flood of information.

In 1976, Gene Glass proposed a method to integrate and summarize the findings from a body of research. He called the method **meta-analysis**. Meta-analysis is the statistical analysis of a collection of individual studies.

> *Meta-analysis refers to the analysis of analyses. I use it to refer to the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. It connotes a rigorous alternative to the casual, narrative discussions of research studies which typify our attempts to make sense of the rapidly expanding research literature.* (Glass, 1976)

The Traditional Approach to Research Integration

Using the traditional method of integrating research studies, a reviewer provides a narrative, chronological discourse on previous findings. Yet this method is flawed and inexact:

- Unable to deal with the large number of studies on a topic, reviewers focus on a small subset of studies, often without describing how the subset was selected.
- Reviewers often cite the conclusions of previous reviews without examining those reviews critically.
- Reviewers are usually active and prominent in the field under review. Therefore, they might not be inclined to give full weight to evidence that is contrary to their own positions.

The Meta-Analysis Approach to Research Integration

In a meta-analysis, research studies are collected, coded, and interpreted using statistical methods similar to those used in primary data analysis. The result is an integrated review of findings that is more objective and exact than a narrative review.

Solving the Complexity Problem

The human mind is not equipped to consider simultaneously a large number of alternatives. (This is true even for bright, energetic researchers.) Confronted with the results of 20 similar studies, the mind copes only with great difficulty. Confronted with 200, the mind reels. Yet that is exactly the scope of the problem faced by a researcher attempting to integrate the results from a large number of studies. As a result,

> *The typical review concludes that the research is in horrible shape; sometimes one gets results, sometimes one doesn't. Then the call is sounded for better research designs, better measures, better statistical methods—in short, a plaintive wish that things were not so complicated as they are.* (Glass, 1976)

When performed on a computer, meta-analysis helps the reviewer surmount the complexity problem. The reviewer can code hundreds of studies into a data set. The data set can then be manipulated, measured, and displayed by the computer in a variety of ways.

Solving the Ambiguity Problem

Researchers can tolerate ambiguity well. Policy makers, however, particularly elected policy makers, have a limited time in which to act. They look to research to provide information that will help them choose among policy options.

Unfortunately, original research, and narrative reviews of the research, often do not provide clear options to policy makers. Senator Walter Mondale expressed his frustration to the American Psychological Association in 1970:

> *What I have not learned is what we should do about these [educational] problems. . . . For every study, statistical or theoretical, that contains a proposed solution or recommendation, there is always another equally well-documented study, challenging the assumptions or conclusions of the first. No one seems to agree with anyone else's approach. But more distressing: no one seems to know what works.*

Solving the Replication Problem

A scientific study should be designed and reported in such a way that it can be replicated by other researchers. However, researchers seldom attempt to replicate previous findings. Instead, they pursue funding for the new, the novel, or—at the very least—they attempt to extend what is considered to be the current state of knowledge in their field. The result can be an overwhelming number of studies on a given topic, with no two studies exactly alike.

In such circumstances, it is difficult to determine if the differences between the study outcomes are due to chance, to inadequate study methods, or to systematic differences in the characteristics of the studies.

Meta-analysis can help you investigate the relationship between study features and study outcomes. You code the study features according to the objectives of the review. You transform the study outcomes to a common metric so that you can compare the outcomes. Last, you use statistical methods to show the relationships between study features and outcomes.

Introducing *Meta-Stat*

Meta-Stat is a computer program that automates the many complex tasks that are required to perform a meta-analysis. With ***Meta-Stat***, you can:

- Code the features of each study
- Transform study findings into a common metric, called the **Effect Size**, so that the studies can be compared
- Apply statistical techniques to the data
- Display the data on a variety of charts

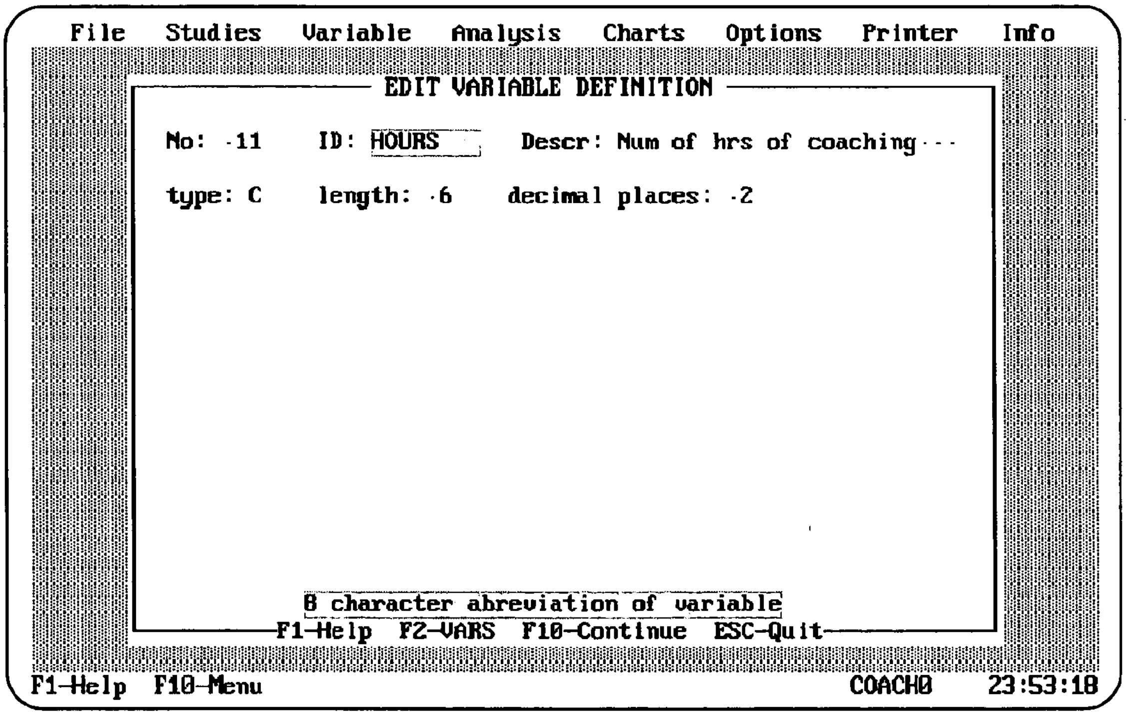
The following sections provide an overview of ***Meta-Stat***.

Coding Study Features

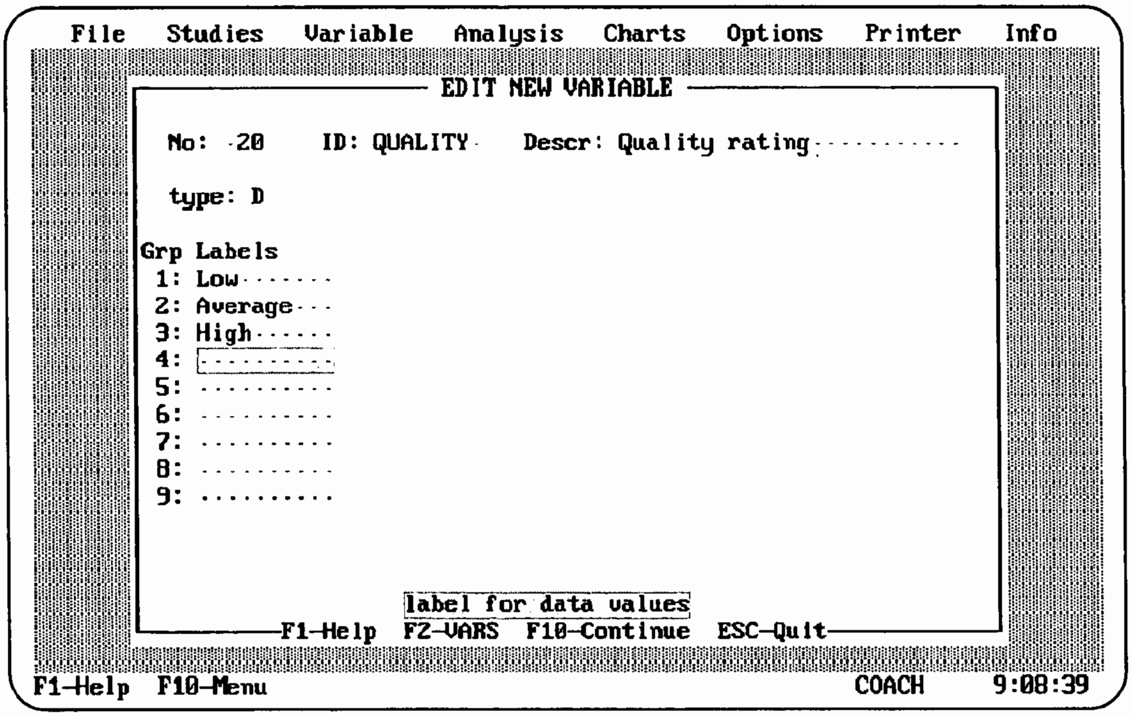
One of your first tasks will be to create variables with which you can code study features. ***Meta-Stat*** offers 10 variables as a starting point, including:

- **Effect Size**
- **Unbiased Effect Size**
- **Sample size**

You can create your own variables to identify features of the studies. For example, suppose you are reviewing studies that investigate the effects of pre-test coaching on Scholastic Aptitude Test scores. You would probably need to create a variable to identify the number of hours of coaching:



You can also create variables to track the characteristics of the studies in your meta-analysis. For example, suppose you want to analyze the relationship between study outcomes and study quality. You can create a variable to identify the quality of each study. In this example, the variable can identify up to three levels of quality:



After creating the variables you need, you use the variables to code the features of each study. The following example shows the entry screen you use to enter data about each study:

```
  File   Studies   Variable   Analysis   Charts   Options   Printer   Info
STUDY ID: ALLEN       TITLE: Effectiveness of study counseling
STUDY NUM: 1 of 31       AUTHORS: Allen, G. J.
 1 EFFECTSZ Effect Size                                            0.918
 2 UNBIASED Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ             0.909
 3 EFFSR_GP Effect size source | 1=Correlation; 2=T-Statistic;
            3=F-Statistic; 4=Chi-Square; 5=Probability Level;
            6=Standardized Difference; 7=Direct Entry; 8=Gain
            Scores (parametric)                                        2
 4 EFF_CLTR Effect size cluster                                        0
 5 PUB_YR   Publication Year                                          67
 6 EXP_N    Experimental Group Size                                   41
 7 CTRL_N   Control Group Size                                        40
 8 TOTAL_N  Total Sample Size
            EXP_N + CTRL_N                                            81
 9 WEIGHT   Inverse of the variance
            (2*TOTAL_N*EXP_N*CTRL_N) / ((2*SQR(TOTAL_N)) + (EXP_N*
            CTRL_N*SQR(UNBIASED)))                                18.351
10 PUBTY_GP Publication Type | 1=journal; 2=dissert; 3=paper;
            4=book; 5=other                                            2
11 HOURS    Num of hrs of coaching
F1-Help F7-Back F8-Next F10-Menu          VAR 1 of 19   COACH0   23:53:58
```

Transforming Study Results into Effect Sizes

In addition to coding the features of each study, you must also code the results. Because results can be reported in different ways in different studies, ***Meta-Stat*** allows you to enter the outcome statistics as reported in the original studies.

Meta-Stat transforms the outcome statistic into the **Effect Size**. The **Effect Size** is the standardized difference between the means of the treatment group and the control group or between the means of two treatment groups. You can read more about the **Effect Size** in Chapter 6.

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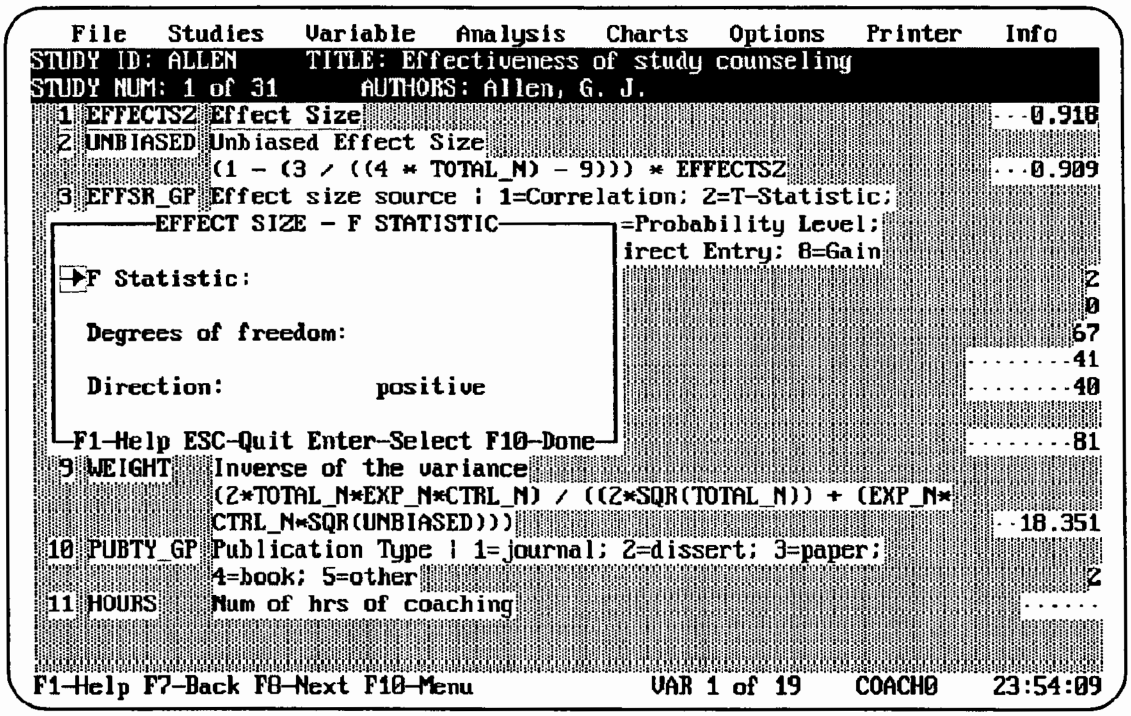
Some study results are more properly described with correlational coefficents, differences between percents, or even odds ratios. ***Meta-Stat*** can also analyze correlations and has routines for correct for several attenuating factors. The plain statistics option can be used for analyzing other types of data.

In the following example, ***Meta-Stat*** will calculate the **Effect Size** from the **F Statistic** reported in the original study.



Applying Statistical Techniques to Your Data

After you enter the coded study features, ***Meta-Stat*** can help you uncover the secrets in your data by applying a full set of statistical techniques.

You can display simple descriptive statistics. This example shows **Descriptive Statistics** for the **Effect Size** variable from a particular meta-analysis:

```
META-STAT                                                        09/10/93
                          DESCRIPTIVE STATISTICS

     Criterion Variable:  UNBIASED   Unbiased Effect Size
     Weighting Variable:
     Select If:

     Number of Valid Observations:      29
     Number of Missing Observations:     1

                             unweighted
                          ____________________
                 Mean    |   0.591
               Median    |   0.479
             Variance    |   0.376
          Stand. Dev.    |   0.613
            Min Value    |  -0.287
            Max Value    |   2.087
                Range    |   2.374

           Hedges's Ht      116.965  (p = 0.000)

Ctrl-P Print  F10 Menu  ↑↓ next variable   PgDn more                 22:14:26
```

You can obtain a host of statistics that are described in the meta-analysis literature as show on the following screen:

```
META-STAT                                                        09/10/93
                         DESCRIPTIVE STATISTICS

    Criterion Variable:  UNBIASED   Unbiased Effect Size
    Weighting Variable:
    Select If:

    Number of Valid Observations:      29
    Number of Missing Observations:     1

                               unweighted
                         ____________________
              Mean ES   |   0.591
          Fisher's Z    |   1.497 (p=0.13)
            Equiv ES    |   0.579
             Equiv R    |   0.278
          Equiv R SQ    |   0.077
          Failsafe N    |       0
           Var Ratio    |   3.750
                        |

Ctrl-P Print  F10 Menu  ↑↓ next variable   PgUp basic             22:15:12
```

Using Regression analysis, you can perform regression calculations using any predictor variables that you choose:

```
META-STAT                                                        09/10/93
─────────────────────────────── REGRESSION ───────────────────────────────

  Criterion Variable:         UNBIASED Unbiased Effect Size
  Predictor Variables:        HOURS
  Weighted by:                WEIGHT   Inverse of the variance
  Listwise deletion
  Solution took 1 iterations

        Multiple R            0.7706       R Square         0.5939
        Adjusted R-Square     0.5776       Standard Error   1.3637

                                      Sum of              Mean
                              DF     squares             square        p
                              ──     ───────             ──────      ─────
             Regression        1    67.9878 Q(R)        67.9878      0.0000
             Residual         25    46.4942 Q(E)         1.8598      0.0001

Ctrl-P Print  F10 Menu                          PgDn More          22:16:20
```

You can study the differences between groups. In the following example from the **Group Means** analysis, ***Meta-Stat*** has calculated the **Effect Size** mean, standard deviation, and 95 percent confidence intervals for a grouping variable called Publication Type. This variable identifies where a study was published:

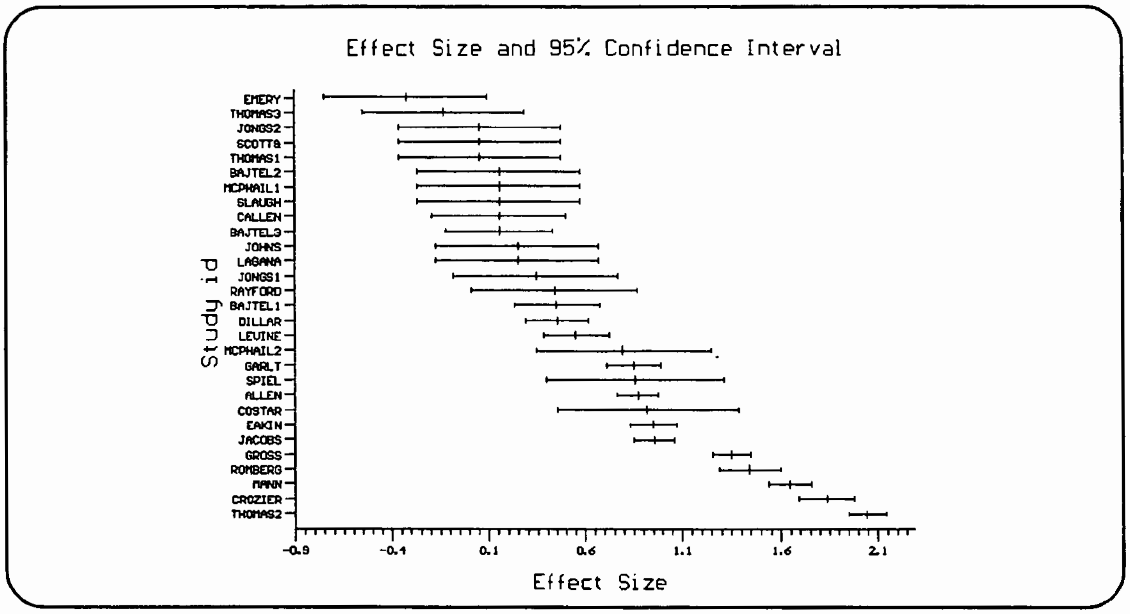
```
META-STAT                                                  09/10/93
------------------------------ GROUP MEANS -------------------------
 Criterion Variable:  UNBIASED



                                 Mean   St. Dev.   N  95% Confid Interval
 PUBYRGRP Year of publication
             1    60-70          1.146     0.413    5    0.671 to 1.620
             2    71-75          0.532     0.534    5   -0.081 to 1.146
             3    76-80          0.557     0.673   15    0.187 to 0.920
             4    81+            0.097     0.260    4   -0.264 to 0.458



                ----- Hedges's Homogenity Tests -----
                Source   Statistic   df
                Total     116.965    28  (p = 0.000)
                Within     97.591    25  (p = 0.000)
                Between    19.373     3  (p = 0.000)

Ctrl-P Print   F10 Menu                                     22:19:45
```

You can also tell ***Meta-Stat*** to create dummy variables from a grouping variable. This allows you to explore the differences between the groups identified by that variable. The following example shows regression results for which dummy variables were created from the variable Publication Type. The results allow you to compare studies based on where the studies were published:

```
META-STAT                                                       09/10/93
                            REGRESSION

    Variable                Beta       B      St Err       t        p

    PUBTY_GP  journal      0.212    0.281     0.344     0.817    0.580
    PUBTY_GP  dissert      0.307    0.451     0.351     1.285    0.197
    PUBTY_GP    paper      0.286    0.325     0.355     0.914    0.636
    PUBTY_GP    other      0.462    1.377     0.426     3.230    0.002
    Constant                        0.508     0.414     1.226    0.219

      Standard errors follow Hedges and Olkin (1985, pages 167-188).

Ctrl-P Print  F10 Menu                        PgUp,PgDn More    22:21:26
```

Displaying Results

Meta-Stat can display your data on a variety of charts. For example, you can show the **Effect Size** and 95 percent confidence intervals for each study:



A wide range of graphic options are available.

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2 Installing and Setting Up *Meta-Stat*

This chapter gets you started with ***Meta-Stat***. It shows you how to install the program and fine tune it for your equipment and tastes.

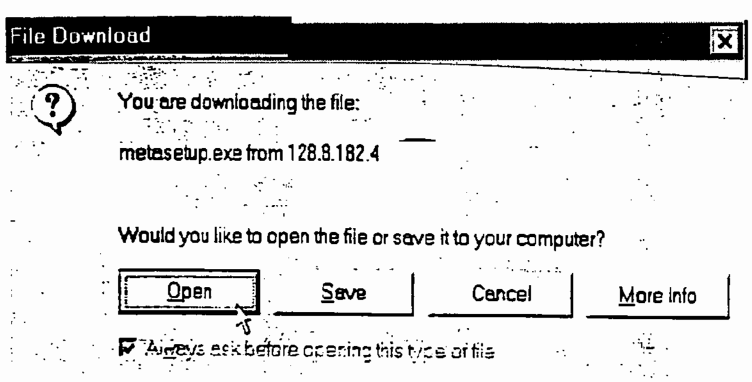
Getting Started with *Meta-Stat*

Installing *Meta-Stat*

Meta-Stat's simple installation process is completely automated. All you need to do is tell ***Meta-Stat*** the disk drive and directory where you want to install the program. Follow these steps:

1. Click on the ***Download Meta-Stat*** link on the Internet.

   You will the following screen



2. Click on Open. The windows-based installation program will then run.

3. Follow the instructions on your screen. We encourage you to accept the default value. This will create links on your start menu and on your desktop

4. ***Meta-Stat*** can be un-installed from either the Start Menu or from the Control-Panel - add/remove software program.

   NOTE: ***Meta-Stat*** uses a .PIF file. They key settings are to run the program using full screen and to enable quick-edit.

Starting ***Meta-Stat***

Follow these steps to start ***Meta-Stat***:

1. Click on the Meta-Stat icon μ/σ on the desktop

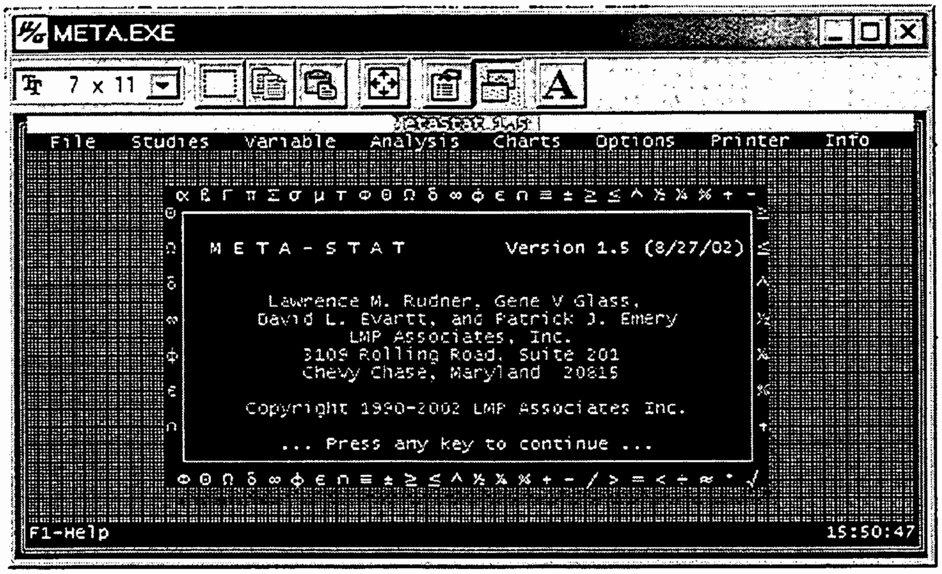
   OR

2. Click on the Meta-Stat icon in your Programs directory (Start / Programs / MetaStat/ Meta Stat)

   OR

3. From the DOS prompt, change to the drive and directory where you installed ***Meta-Stat***. and type **META** to start ***Meta-Stat***.

You should see the ***Meta-Stat*** main screen:



NOTE: Use ***Meta-Stat*** in full-screen mode rather than a smaller window. This will ensure proper mouse and graphic functioning. Push **Alt-Enter** from windows to change screen size.

Start-Up Options

You can use two options when you start ***Meta-Stat***:

- Use **META *filename*** to start ***Meta-Stat*** and open the meta-analysis stored under ***filename***. If you do not use this option, you must use **File/Open** to open a meta-analysis once you start ***Meta-Stat***.
- Use **META -m** to start ***Meta-Stat*** in monochrome mode.

Exiting from *Meta-Stat*

You can exit from *Meta-Stat* in two ways:

- Open the **File** menu and select **Exit**

  To find out how to work with menus, see "Using the *Meta-Stat* Menus" later in this chapter.

- Press and hold down **Ctrl**, then press **X**.

If you have made changes to the current meta-analysis, *Meta-Stat* prompts you to save your changes.

Using the *Meta-Stat* Menus

Meta-Stat offers pull-down menus from which you can select options.

General Menu Characteristics

- After you start *Meta-Stat*, your first keystroke opens the **File** menu, because the program assumes you want to open or create a meta-analysis.
- If a menu option is not highlighted, you cannot select it.

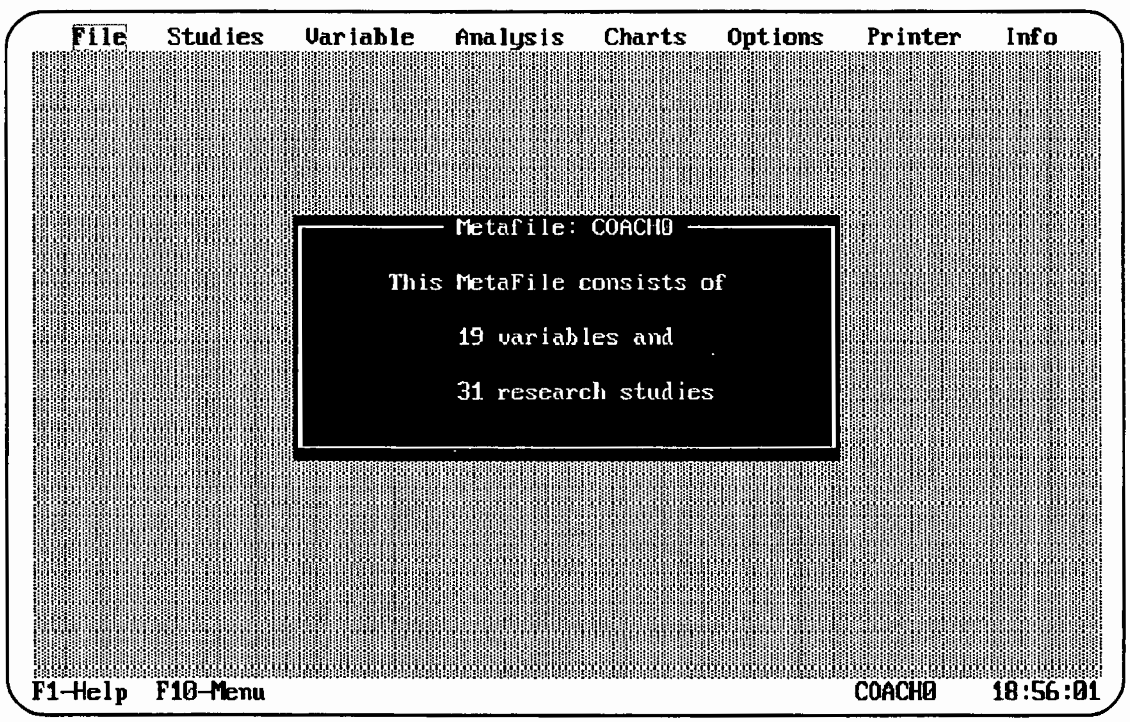
  For example, if you have not yet opened a meta-analysis, the **Save** and **Save as** options on the **File** menu are not highlighted because you do not yet have anything to save.

- Press **F10** to get back to the menus after you finish working with a menu option.
- Open or close the menus with either the keyboard or the mouse. See the following sections for details.

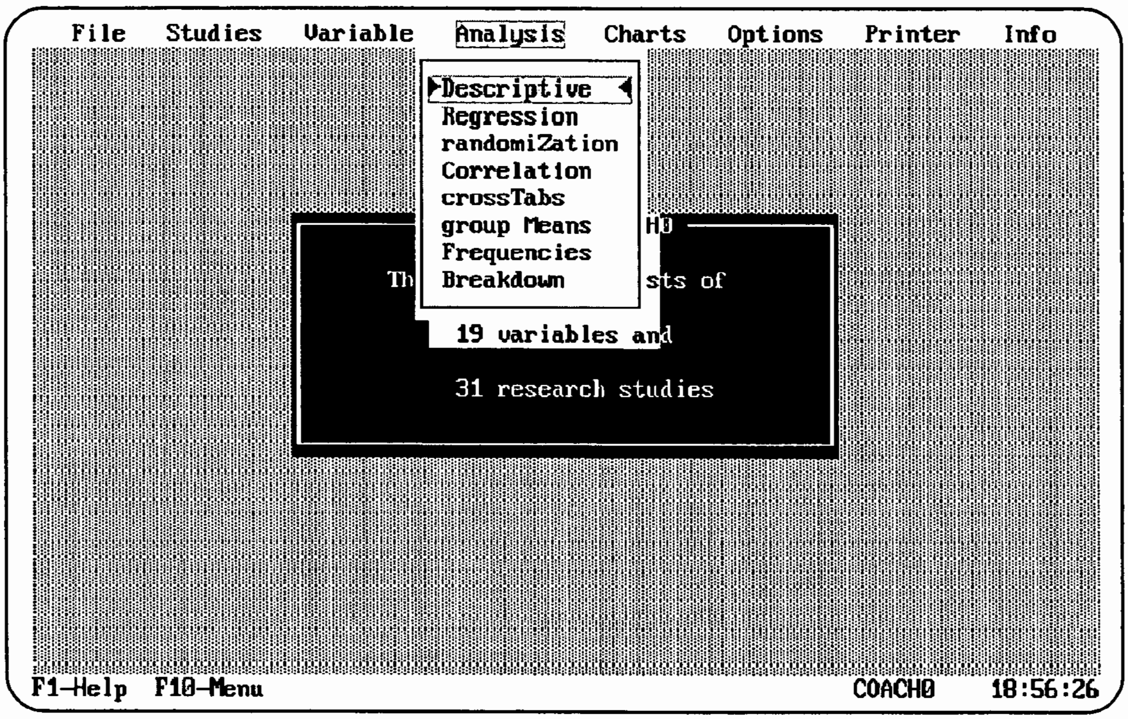
Controlling the Menus with the Keyboard

- You can close the menus by pressing **Esc**.
- Press ← and → to highlight menus to the left and right, respectively.
- If the menus are closed, you can pull down a menu either by:
  - Typing the first letter of the menu name, or
  - Highlighting the menu name by pressing the ← and → cursor keys until the name is highlighted, then pressing **Enter.**

For example, suppose you have closed the menus by pressing **Esc**, as shown here:



You can now open the **Analysis** menu by typing **A**, or by highlighting the menu name and pressing **Enter** or left-clicking:



- After opening a menu, you can select an available option by:
    - Typing the highlighted letter of the option name, or
    - Highlighting the option by pressing the cursor keys until the option is highlighted, then pressing **Enter.**

For example, with the **Analysis** menu open, you can select the **crossTabs** analysis by typing the highlighted letter in the option name—T. You can also press ↓ until **crossTabs** is highlighted, then press **Enter.**

Controlling the Menus with the Mouse

- The mouse works in a way similar to the keyboard, except that you use the left button for **Enter** and the right button for **Esc**.
- You can close the menus by right-clicking.
- Move the mouse to highlight menus to the left and right, respectively.
- If the menus are closed, you can pull down a menu by moving the mouse until the menu name is highlighted, then left-clicking.

Using Quick Keys for Menu Options

Meta-Stat uses **Ctrl** to provide quick-keys for some menu options. You can use the quick-keys to select these options from anyplace within ***Meta-Stat***. You do not have to pull down the appropriate menu first.

For example, you can press **Ctrl-Q** to quit from anywhere within ***Meta-Stat***. You do not first have to pull down the **File** menu, where the **Quit** option is listed. When you use a quick-key, you must press and hold down **Ctrl**, then press the letter key.

The quick-keys are listed on the menus and in the chart below. The **^** symbol is used to represent the **Ctrl** key.

Quick-Key	Description
^S	Save your data
^X	Quit *Meta-Stat*
^R	Recompute the values of all variables in the meta-analysis that are based on equations
^N	Create a new variable
^E	Edit a variable
^K	Kill any print jobs that are currently printing

Configuring Your Display

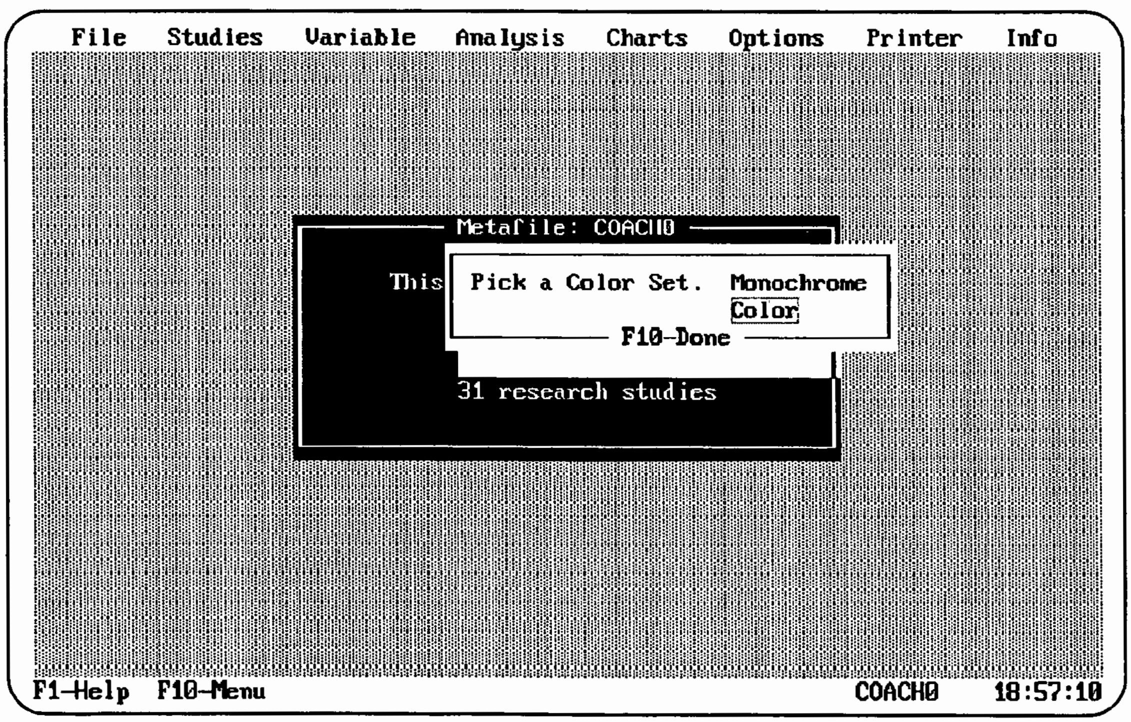
Meta-Stat offers a variety of display options. You can display ***Meta-Stat*** screens in color or monochrome, and you can select from three screen sizes. For example, you can choose to display 50 lines on your screen, making a large amount of data visible at once.

You can also turn sound effects on and off, and you can refresh the screen to make it more readable.

The following sections display your options.

Setting Display Options

1. Select **Options/Colors.**
2. Highlight either **Color** or **Monochrome** and press **Enter**.



3. Select **Options/scrEen Size**

4. Select the number of lines you want to display—25, 43, or 50. Make sure that your display equipment is capable of the resolution you select.

5. Select **Options/Save Config** to save your display settings.

Turning Sound Effects On and Off

When you make an error, ***Meta-Stat*** beeps. You can turn off this sound if it annoys you.

Select **Options/sound eFfects**. ***Meta-Stat*** removes the check-mark next to this menu option, to indicate that it is turned off.

Select the option again to turn the sound back on.

Refreshing the Screen

As you use ***Meta-Stat*** and create studies, modify variables, and enter data, the screen might become garbled. Nothing is wrong with your data; only the screen display is incorrect.

To refresh the screen, select **Options/Refresh Screen**.

Configuring Your Mouse

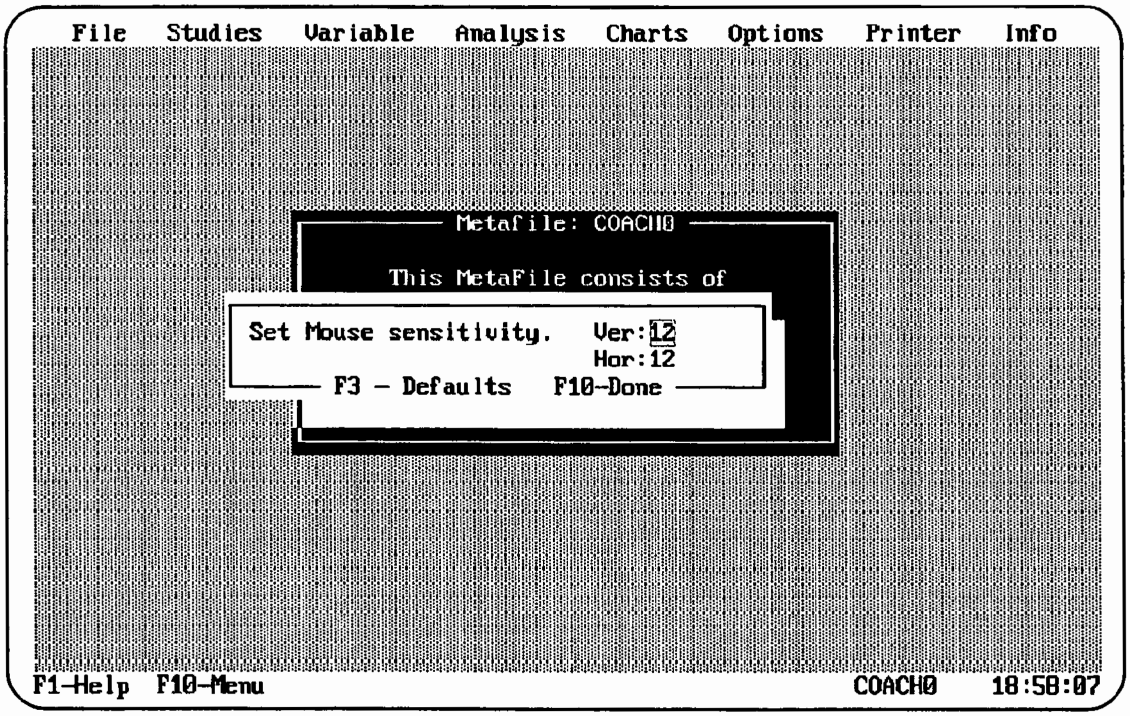
When you create graphs with ***Meta-Stat***, you can use your mouse to point and click on a data point to display more information about the data. If your graphs contain a large number of data points, you can make your mouse more sensitive, allowing you to fine tune the mouse's location on a data point more precisely. *See Chapter 8 for more information about graphing.*

NOTE: ***Meta-Stat*** does not include basic mouse-driver software. This software, which came with your mouse, must be loaded before you start ***Meta-Stat***. Consult your mouse documentation for more information.

To control the sensitivity of your mouse, follow these steps:

1. Select **Options/Mouse Speed**

   Meta-Stat prompts you to identify the mouse sensitivity in terms of horizontal and vertical units. These units are the number of screen pixels the mouse pointer moves at one time.



2. Type the number of pixels you want the pointer to move. Larger numbers cause faster but less precise movement, because the mouse pointer jumps more pixels with each movement.
3. Press **F10** when you have finished.
4. Select **Options/Save Config** to save your mouse settings.

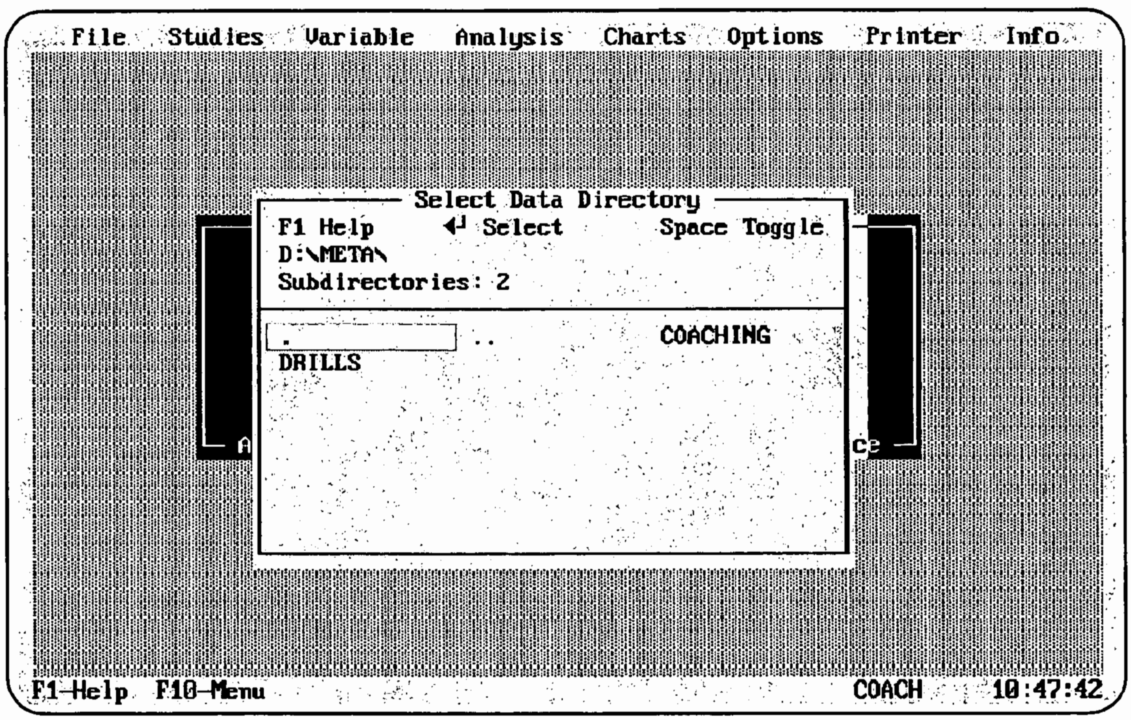
Setting the Default Directory

When you work with meta-files, ***Meta-Stat*** assumes you want to get files from and save them to the directory in which ***Meta-Stat*** was installed. You can change the directory that ***Meta-Stat*** uses as a default.

Follow these steps:

1. Select **File/cH Directory**

2. ***Meta-Stat*** displays a list of directories in the ***Meta-Stat*** directory. In the following example, there are two directories, **COACHING** and **DRILLS**:



3. Use the **cursor keys** or your mouse to move the highlight to the directory you want to use, then press **Enter**.

   To select a directory that is at a higher level in the directory structure, highlight the **..** and press **Enter**.

4. To tell ***Meta-Stat*** you have finished, highlight the **.** and press **Enter**.

Printing with *Meta-Stat*

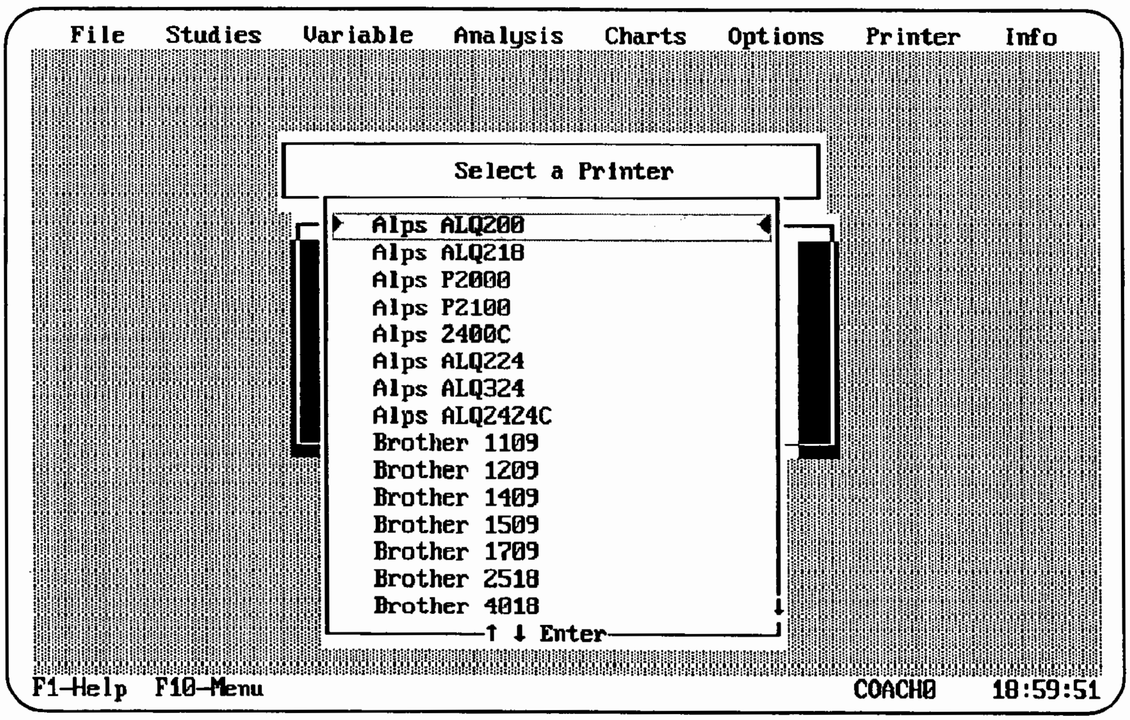
Meta-Stat provides a variety of printing options. You can print variable definitions, studies, statistical analyses, and even graphs. The following sections describe how to configure your printer and print with ***Meta-Stat***.

Setting Up Your Printer

You must identify your printer to ***Meta-Stat***. You can do this at any time. Follow these steps:

1. Select **Printer/Select Printer**

   Meta-Stat displays a list of printers that it supports:



2. Scroll through the list, by pressing ↓, until you have highlighted your printer.

   NOTE: If you do not see your printer in the list, select a printer that is compatible with yours.

3. Press **Enter** when you have finished.

4. If your printer can print output in both portrait and landscape orientations, use **Printer/Orientation** to select the orientation you want to use.

5. If your printer can print in color, use **Printer/Colors** to control color printing.

6. Use **Printer/Printer Port** to identify the port to which your printer is attached.

   NOTE: If your printer is attached to a COM port, ***Meta-Stat*** asks a series of questions about the port's communication settings, including the flow rate, stop and start bits, and parity. For most situations, the default settings should work properly.

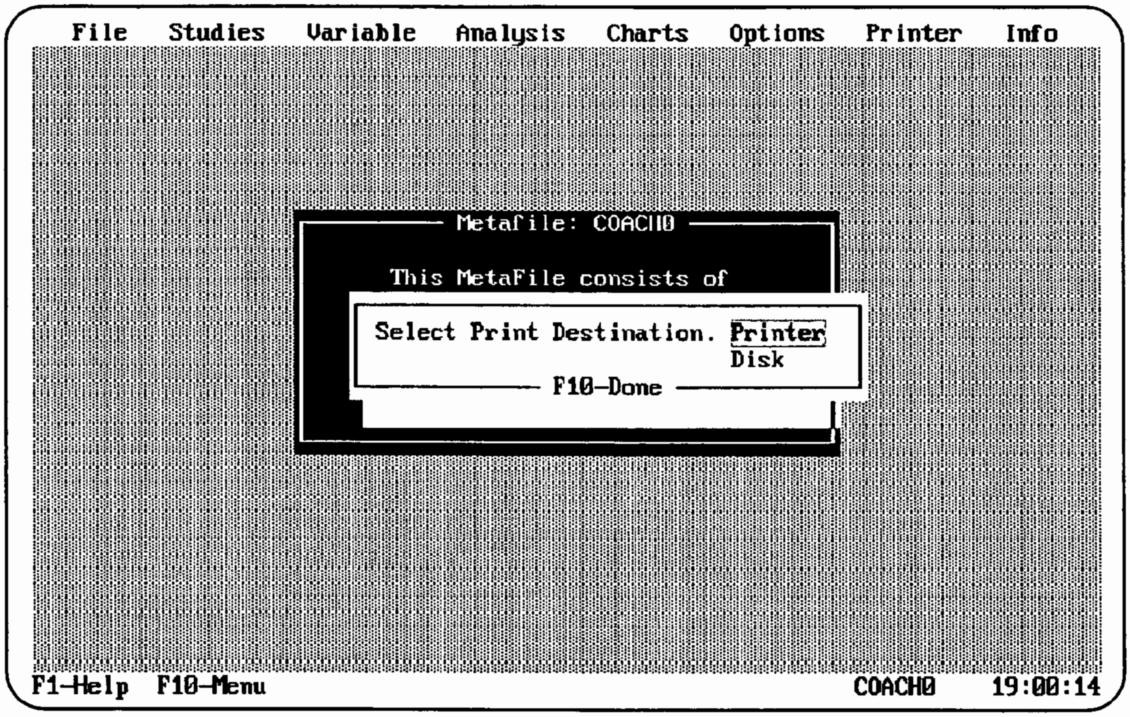
7. Select **Options/Save Config** to save your printer settings.

Printing to Paper or Disk

You can print output on your printer, or you can route the output to a disk file. You might route output to a disk file if you need to share it with other applications, or if your printer is not currently available.

1. Select **Printer/Destination**.

   Meta-Stat asks you where to send printed output:



2. Select the destination you want to use.

File Names for Disk Files

If you select **Disk** as the destination for printed output, ***Meta-Stat*** saves the output in a disk file:

- In the ***Meta-Stat*** directory
- Under a file name of **PRINTER**
- With an extension of **001** for the first printer-output file, **002** for the second, and so on.

For example, **PRINTER.001** is the name of the first printer-output file that you create. **PRINTER.012** is the name of the twelfth.

You can delete these files if you no longer need them.

Spooling Print Jobs

Meta-Stat has an exceptional built-in print spooler which will print your work as a background task. In most cases you will want to turn this option on. If you are on a network or are having printing problems, try turning this option off.

Killing Print Jobs

Use **Printer/Kill print jobs** to stop spooling output to the printer. Once a file or graph has been spooled, this option is no longer effective.

3 Setting Up a *Meta-Analysis*

Traditional, narrative reviews of research literature are selective. Critics of such studies rightly ask, "Why were some studies selected but not others? What criteria were used? What kind of bias did the selection process introduce into the review?"

A meta-analysis should be comprehensive and replicable. It should not only examine as much of the research as possible, it should also describe how you found the research so that other researchers can evaluate *your* work.

This chapter describes the tasks required to organize and conduct a meta-analysis.

Focusing Your Aim

Before setting out to collect studies, you must first decide the range of topics your review will encompass. Meta-analyses typically cover broad topics, sometimes loosely defined topics. They examine questions such as, Does psychotherapy work? Does computer-assisted instruction lead to more learning than traditional instruction? Is mastery learning better than traditional learning?

These questions, by themselves, are too broad to be meaningful. Does "psychotherapy," for example, mean reading a self-help book, or spending a few sessions with a college counselor, or completing a multi-year psychoanalysis?

To avoid vague generalities, you must make the focus of your meta-analysis much more explicit by establishing criteria for including or excluding studies. However, the criteria cannot be too restricting, or you might not find a sufficient number of studies; and even if you do find enough studies, you might not find anything interesting or illuminating.

To focus your aim, read a good sample of the literature and develop a thorough understanding of the concepts and methods that you want to analyze. Determine the effect, or outcome, you want to study, as well as the predictors, or independent variables, that you want to measure.

Conducting the Literature Search

A thorough literature search is critical to the validity of your meta-analysis:

> *How one searches determines what one finds; and what one finds is the basis of the conclusions of one's integration of studies.* (Glass, 1976)

Finding research studies is difficult and time-consuming. The studies can be located in a variety of places, and often you must look beyond the titles. For example, if you are conducting a meta-analysis of sex differences, you will find that some studies show such differences even when that is not the principal variable of interest in the study and even when the study title makes no mention of sex differences.

To find studies, check the following general categories described by Rosenthal (1984):

- Books

  - Authored books
  - Edited books
  - Chapters in edited books

- Journals

  - Professional journals
  - Published newsletters
  - Magazines
  - Newspapers

- Theses

  - Doctoral theses
  - Master's theses
  - Bachelor's theses

- Unpublished work

  - Technical reports
  - Grant reports
  - Convention papers not published in proceedings
  - ERIC reports
  - Films and cassette recordings
  - Other unpublished work

Also consider soon-to-be-published works. Given the time lags between data collection, write-up, journal acceptance, and publication, the latest word on a topic may well be in the pipeline to publication. Your literature search should produce a list of names you can contact with inquiries about recent research. These researchers will also know about others who are doing research on similar topics.

Last, and perhaps most important, consult secondary sources such as review periodicals and the myriad abstract archives that are available in most fields of study. These sources will help you identify the primary research that will be the subject of your meta-analysis.

Handling Questions of Study Quality

One of the most controversial questions related to meta-analysis is the question of whether to include studies that are of doubtful or poor quality. Some critics invoke the Garbage-In, Garbage-Out principle by arguing that any meta-analysis that summarizes studies of widely differing quality is likely to be uninformative or flawed. These critics argue that studies with methodological flaws should be eliminated from consideration in the meta-analysis.

Others counter by noting that it is often difficult to assess methodological quality and researchers often disagree on quality. Despite a researcher's best attempts to provide an objective measure of quality, decisions to include or exclude studies introduce bias into the meta-analysis.

Others note that the quality of a study may not have an effect on the study's outcome. When in doubt, include the study in the meta-analysis and use an independent variable to code the quality of a study. Then examine empirically whether the outcome does in fact vary with study quality. You can do this with ***Meta-Stat*** by examining the relationship between study quality and **Effect Size**.

Dealing with Publication Bias

Well-recognized publication biases can produce bias in your meta-analysis.

First, publication policy is biased toward statistically significant findings. In other words, it is easier to get published if you have something statistically significant to report. A number of meta-analyses have indeed found that effect sizes reported in journals differ widely from unpublished work. The **Effect Size** is about 33 percent larger in published research.

Second, publication biases can skew the direction of effect. For example, Smith (1980) reported that, in the published literature, counselors and therapists tend to view women more negatively than men. In the unpublished literature, the opposite is true. As Strube (1985) theorized:

> *Such biases probably reflect the fact that some findings better "fit" the prevailing scientific atmosphere (Zeitgeist) and are scrutinized less closely than are novel or counterintuitive results.*

To overcome publication bias, gather everything you can find, both published and unpublished. You can then use empirical methods to examine the question of publication bias. For example, with ***Meta-Stat*** you can compare the effect sizes for published research and unpublished work.

Documenting Your Search

A traditional, narrative review of literature often devotes only one or two paragraphs to a discussion of the methods that were used to conduct the literature search. A meta-analysis requires a much more rigorous approach. Only through a comprehensive description can other researchers evaluate the validity of your work and, perhaps, gather clues about overlooked sources.

Creating the Meta-Analysis in *Meta-Stat*

Before you can define your variables in ***Meta-Stat***, as described in the following sections, you must create the meta-analysis in ***Meta-Stat***. Chapter 4 of this manual describes how to create and modify the set of data files that, together, make up a meta-analysis. *See Chapter 4 for complete information.*

Defining Variables

After you collect the literature for your meta-analysis, you must determine which study features your meta-analysis will examine. These features become the variables in the meta-analysis.

Classes of Variables

There are three classes of variable:

- Variables that identify characteristics of the **study**

  You will need some variables to identify when and where the research was published, whether a control group was used, the type of effect that was measured, and so forth.

  These variables will help you show the relationships, if any, between study methodology and results.

- Variables that identify characteristics of the **sample**

  Use these variables to identify the subject population—age, educational level, socioeconomic status, and so on.

- Variables that identify characteristics of the **intervention**

  These variables could include the type of treatment or intervention, its duration, the type of effect that was measured, and so on.

Variables for a Meta-Analysis of the Effects of Psychotherapy on Asthma

Schlesinger et al. (1978) conducted a meta-analysis that evaluated the effects of psychotherapy on asthma. This meta-analysis found that psychotherapy does indeed significantly lessen both the medical and nonmedical effects of asthma.

In the meta-analysis, the following variables were used:

This variable ...	Was used to identify ...
Therapy Type	Type of psychotherapy received by treatment subjects For example, some subjects received hypnotherapy while others received group therapy.
Age	Average age of subjects
Hours of Therapy	Number of hours that subjects received therapy
Control Group	Type of therapy received by the control group Some control subjects received no treatment, others received relaxation therapy, and others received medical treatment.
Follow-Up Time	Amount of time between the end of treatment and the measurement of the outcome variable
Dependent Variable	The type of outcome or effect that was measured For example, some studies measured the effect of psychotherapy on the use of drugs to treat asthma; others measured the effect on asthma attacks and hospitalization.
Effect Size	The size of the effect of treatment

Variables for a Meta-Analysis of the Effects of Coaching on SAT Scores

Becker (1990) conducted a meta-analysis that tested the effects of coaching on Scholastic Aptitude Test scores. Among other results, this meta-analysis found that the effectiveness of coaching varied widely across the studies, with much of the variation resulting from studies without comparison groups. The magnitude of the coaching effect is related to study design and to the duration of coaching intervention.

The following table describes some of the variables that were used in the meta-analysis:

This variable ...	Was used to identify ...
Year of publication	Year the study was published
Type of publication	Whether the article was published in an academic journal
ETS Authorship	Whether any author was affiliated with Educational Testing Service, which develops and administers the SAT
Control Group	Type of control group
Use of randomization	Whether subjects were randomly assigned to control and coaching groups
Selectivity	The type of students in the study (e.g. low achievers, public-school students, college-prep students)
Voluntariness	Whether participation in coaching was voluntary or compulsory
Duration	Length of coaching program
Presence of Test Practice	Whether students practiced taking complete sample tests
Homework	Whether students were given coaching-related exercises for completion at home
Use of Computerized Instruction	Whether students were given computerized practice

Deciding Which Variables to Use for Your Meta-Analysis

In some cases, simple analysis will help you decide which variables are required for a meta-analysis. But it's not always so simple. Definitions of study features may vary from study to study, and different researchers often use different terminology.

The safest procedure is to have two researchers independently code all study features, then negotiate an agreement in places where they disagree.

Setting Up Variables in *Meta-Stat*

Chapter 5 describes how to create and modify variables in ***Meta-Stat***. The program comes with many variables already predefined for you. There are variables to measure:

- Study characteristics, including the year of publication and the type of publication in which the research appeared
- Sample characteristics, including the sizes of the treatment and control groups
- Intervention characteristics, including the **Effect Size** and the **Unbiased Effect Size**

You can also create your own variables to handle other study features. You can create different types of variables to handle different types of data. *See Chapter 4 for complete information about **Meta-Stat** variables.*

Coding the Results of Each Study

After defining the variables you will use to measure studies, you must obtain the studies and code data for each variable.

Unfortunately, this task is not as straightforward as it might seem. Meta-analysts sometimes find that the required data are missing and must be estimated. Sometimes, researchers find errors in the original research. Errors in the publication are relatively easy to correct. But that is not the case for errors that were made when the data were originally recorded. These errors will contaminate your meta-analysis, but it is no easy matter to determine whether that contamination is severe.

Dealing with Data Errors

In social science research, errors commonly occur in favor of the anticipated outcome. In one study, researchers gave genetically identical white rats to students. The researchers told the students that some of the rats were fast runners and some were slow. When the students recorded running times in a maze, the "fast" rats had faster times than the "slow" ones.

Another study collected the original data from 27 published studies. The median error rate was about 1 percent, but rates of 3 percent and 4 percent were not uncommon. Two-thirds of these errors supported the researcher's hypothesis. Of course, if the researchers were unbiased, half of the errors should have supported the hypothesis and half should have countered it.

Dealing with Data Reporting Deficiencies

The scientific method requires researchers to report their studies in enough detail that anyone who wants to replicate a study can do so. Unfortunately, published research seldom exhibits the required clarity and detail. Further, there is no standardization among different journals—or even within a journal, as editors change—about what all studies must contain. About 40 percent of all studies even lack the means and standard deviations that are important to most meta-analyses. Fortunately, this deficiency does not make a meta-analysis impossible.

Deficient reporting can affect your meta-analysis by forcing you to exclude variables that, although potentially important, are not described in the study results. Deficient reporting can also force you to abandon precise variables in favor of rougher groupings of data. This problem causes less variance in your variables and attenuates important relations in your data.

In your meta-analysis, it may be useful to add a variable that you can use to rate data quality. If you rate the quality of each study's data on a three-point scale, you can then examine whether the quality of reporting systematically affects the outcomes of studies.

Entering Study Data into *Meta-Stat*

Chapter 6 describes how to enter each study into your meta-analysis. For each study, you must identify the author and title. You must then enter data from the study for each variable that you have set up. *See Chapter 6 for full information.*

Analyzing and Displaying Results

Chapters 7 and 8 describe how to analyze and display the results of your meta-analysis.

Chapter 7 describes the statistical techniques you can use to explore your data. Chapter 8 describes the graphs you can use to analyze and display results.

First Steps

The meta-analyst is well advised to perform a number of very basic analyses before launching into more complex analyses in which some of the more basic features of the data base are obscured. Specifically, after entering the data, it is wise to perform simple frequency distributions and scatter plots to see if data have been entered correctly or whether some studies contain data that are clearly aberrant in the context of all studies in the analysis. These aberrations can occur in a variety of ways. Most simply, perhaps, are clerical errors committed in the entry of the data into Meta-Stat. Bad data points can enter the process earlier: typos in printed reports of the studies; data analysis errors in the primary data analysis that yield an F-ratio in error by a factor of two or three, for example; or conditions invalidating the transformation of a reported statistic into an **Effect Size** or correlation coefficient. However they arise, these errors produce odd values of variables that can distort the analysis of the study outcomes and their relationships with study characteristics. The errors need to be detected and corrected or removed.

Two analyses are particularly useful to this end. Under **CHARTS** can be found the options of **BAR GRAPH** and **EFFECT SIZE BY STUDY**. An early analysis should be the graphing of **EFFECT SIZE** (or **CORRELATION** in the case of correlations as the study outcome) as a **BAR CHART**. The results are then inspected for a small number of entries that are clearly separated from the bulk of the distribution of effects. How far removed from the mean or the next closest entries is "clearly separated"? No definitive answer can be given. Values more than five standard deviations from the mean in samples of 100 or fewer cases would certainly raise suspicions about errors in reporting or calculation. But it is difficult to be more precise than this here. (The reader interested in pursuing this point to a more precise answer should consult Dixon & Massey, 1969, or Tukey, 1977.)

The graph of **EFFECT SIZE BY STUDY** can add information to the **BAR GRAPH**. All effect sizes are arrayed in either ascending or descending order and each is bracketed by a confidence interval that reflects on the size of the samples in the study yielding the **Effect Size**. If the largest or smallest of these effects are very distant from their neighbors and the confidence intervals are likewise quite distinct and not overlapping, then it might be well to return to the studies that produced these effects and see if some error is apparent. Not every aberration will have a simple explanation; when they lack reasons, the analyst is faced with the difficult question of eliminating the odd data point without good reasons or leaving it in and having it exercise undue influence on the later statistical analyses.

The problem of detecting outliers can be more complex than indicated above. Consider the follow data, which for the sake of example can be thought of as **Effect Size** from nine experiments in which a drug is tested against a placebo: .40, .45, .50. .55, .60, .75, .80, .85, .90. There appear to be no outliers or aberrant data points here. But suppose that the first four and the ninth effect sizes are from studies that are double blind and the fifth through the eighth effects are from single blind experiments: when the effects are grouped and inspected, the value of .90 appears aberrant and sends the analyst looking for errors or explanations:

Single Blind Effects: .60 .75 .80 .85

Double Blind Effects: .40 .45 .50 .55 .90

Consequently, it is advisable not only to inspect the entire data set for outliers but to break down the whole data set into various groups to see if aberrations appear when effects are compared with effects observed under similar conditions. Perhaps the best way to accomplish this analysis is to select **EFFECT SIZE BY STUDY** under the **CHARTS** menu and then **use SELECT IF** to construct selection criteria to view the effects for various subgroups of discrete study characteristics.

For continuous study characteristics, the counterpart to the above analysis is a scatter plot relating the study characteristic to the study outcome (e.g., **EFFECT SIZE**). When **SCATTER PLOT** is selected from the **CHARTS** menu and **EFFECT SIZE** plotted against a study characteristic, a quick visual fitting of the relationship will reveal points that fall far away from the general relationship between the two variables. The studies contributing these outliers can be identified with the **POINT SHOOT** feature, and reread or checked for obvious errors.

An alternative means of detecting bad data points is to perform **REGRESSION** analyses under the **ANALYSIS** menu and inspect the residuals graph that the analysis produces. Very large and aberrant residuals identify data points that have peculiarities unrelated to the study characteristics used in the regression.

Although outliers can be critical when they occur in the study outcome variable, say **EFFECT SIZE**, they can occur in other places in a data set. Occasionally they cause problems in subsequent analyses. The methods suggested above for searching for outliers in study outcomes can also be applied to any other variable (with the exception of the **EFFECT SIZE BY STUDY** graph that is only available for the **Effect Size** variable). In addition, the **BREAKDOWN** tables under **ANALYSIS** are useful in detecting bad data points in Grouping Variables that describe study characteristics.

A Comment on Schmidt and Hunter Meta-Analysis

The effect-size meta-analysis approach in ***Meta-Stat*** tends to follow the concepts outlined by Glass and by Hedges. These techniques are very similar to those of Schmidt-Hunter, but they do differ in several critical ways. Schmidt and Hunter argue that:

1) the **Effect Size** should be based on the pooled variance estimate rather than that of the control group,

2) the meta-analyst should correct for sampling error, and

3) the meta-analyst should correct for measurement error.

The argument for using the pooled variance estimate is that it is based on more observations and subject to less error than the control group variance estimate. The counter argument is that the control group variance is unaffected by the treatment. The effect-size calculator in ***Meta-Stat*** lets you choose your technique. In practice there will be very little difference.

Schmidt and Hunter recommend grouping, trimming, or selecting your data until the ratio of the error variance to the variance of the effect sizes is .75 or greater. They argue that if 75% of the variance is due to error, then the rest of the variance is probably also due to error. Therefore the population variance is zero and the model of a single **Effect Size** is consistent with the data. ***Meta-Stat*** provides you with their variance ratio under Analysis/Descriptive when the criterion variable is **UNBIASED**.

Their last key recommendation is to correct for study artifacts such as the lack of perfect reliability of the criterion measure and data dichotomization. For example, they recommend correcting for measurement error by dividing the effect-size estimate by the square root of the reliability of the criterion variable. They note that measurement error inflates the standard deviation and thus lowers the **Effect Size**. ***Meta-Stat*** can accommodate this correction. The program allows you to override values entered into an equation when one or more of the variables are missing. Thus, you can correct for measurement error and other artifacts by following these steps.

1. Use the **Effect Size** calculator to compute **EFFECTSZ**.

2. Manually divide the **EFFECTSZ** (or **UNBIASED**) value by the square root of the dependent measure reliability (reliability for commercial tests can be found in the *Buros Mental Measurements Yearbook*).

3. Divide the above value by other correction formulas if desired and available.

4. Delete the value for **EFFECTSZ**.

5. Insert the corrected effect-size in **UNBIASED**.

Not all meta-analysis methodologists will agree with each of Hunter & Schmidt's recommendations. We diverge from their plan in at least three respects. It seems unwise to contaminate the variance estimate with the treatment effect. Furthermore the 75% rule-of-thumb test is quite arbitrary and not in the spirit of intelligent, contextualized data analysis. Third, corrections for measurement unreliability often make conceptual sense but are impossible to implement. Finding a test reliability (in a book or manual or from a computer printout) is one thing; but assessing a sensible and appropriate error variance is quite another. The error that enters the control group variance estimate and contributes to observed differences among persons is generally not the error assessed by ordinary convenient measures of test reliability like Cronbach's Alpha, Kuder-Richardson or various split-half coefficients. In addition, after reanalyzing several meta-analysis studies using the Glass and the Schmidt-Hunter techniques, Hough and Hall (1991) demonstrated that the corrections are trivial and that both approaches lead to the same conclusions.

Summary of Steps for a Meta-Analysis

To conduct a meta-analysis:

1. Focus your aim by deciding on an area of the literature that you want to explore and a specific topic that you want to analyze.

2. Conduct a thorough literature search.

3. Create the meta-analysis in ***Meta-Stat***. *See Chapter 4.*

4. Add variables that you will use to code study features. *See Chapter 5.*

5. Read the studies and code the variables for each study.

6. Enter the data for each study into ***Meta-Stat***. *See Chapter 6.*

7. Explore and display the data with various statistical techniques. *See Chapter 7 and 8.*

4 Managing Files

This chapter describes how to open and save your meta-files, and how to share the data in a meta-file with other applications, such as SPSS.

Creating a Meta-file

Your first task in performing a meta-analysis is to create a meta-file. A meta-file holds the following information:

- Variables that you will use to conduct your meta-analysis
- Studies that you will analyze

A meta-file is actually two DOS files. For more information, see the section "Keeping Backups of Your Data" later in this chapter.

Follow these steps to create a meta-file:

1. Select **File/New**
2. If necessary, close any open meta-file by following these steps:
   - If you have already opened a meta-file, ***Meta-Stat*** asks if you want to close it. Press **Y** or **N**.

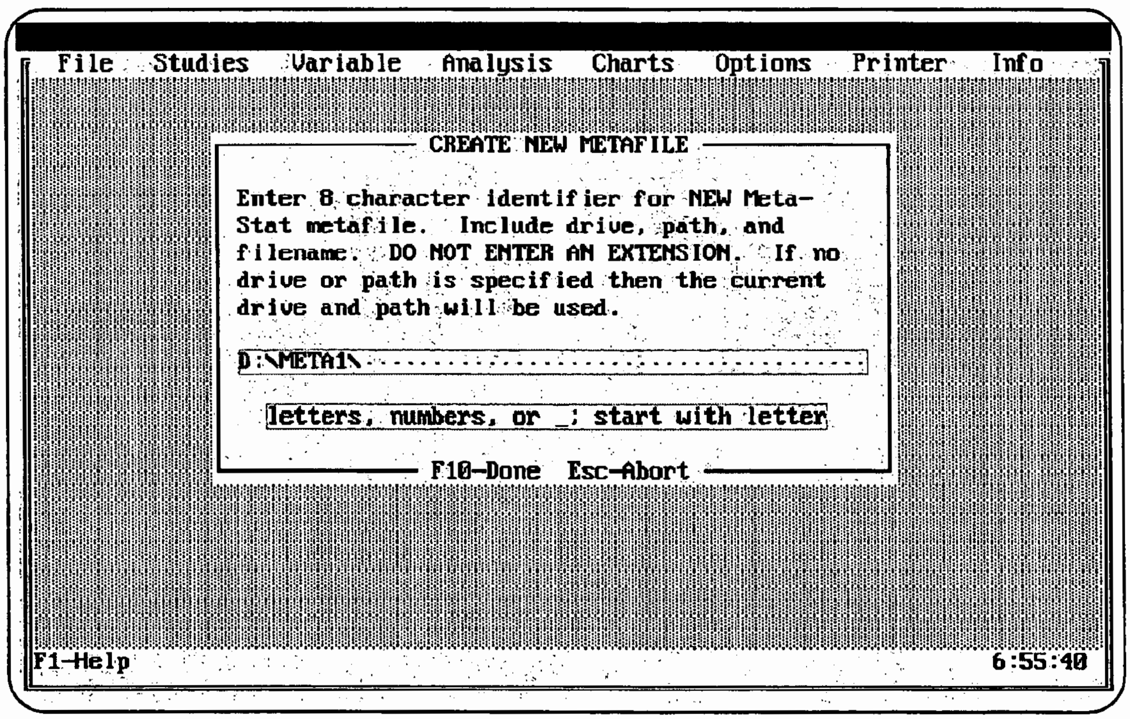
- If you tell ***Meta-Stat*** to close the open file, and you have made changes to it, ***Meta-Stat*** asks if you want to save your changes. Press **Y** or **N**.

3. Type a name, up to eight characters long, for the new meta-file. The name should provide a good description of the meta-file, so that you can distinguish one meta-file from another on ***Meta-Stat*** screens.

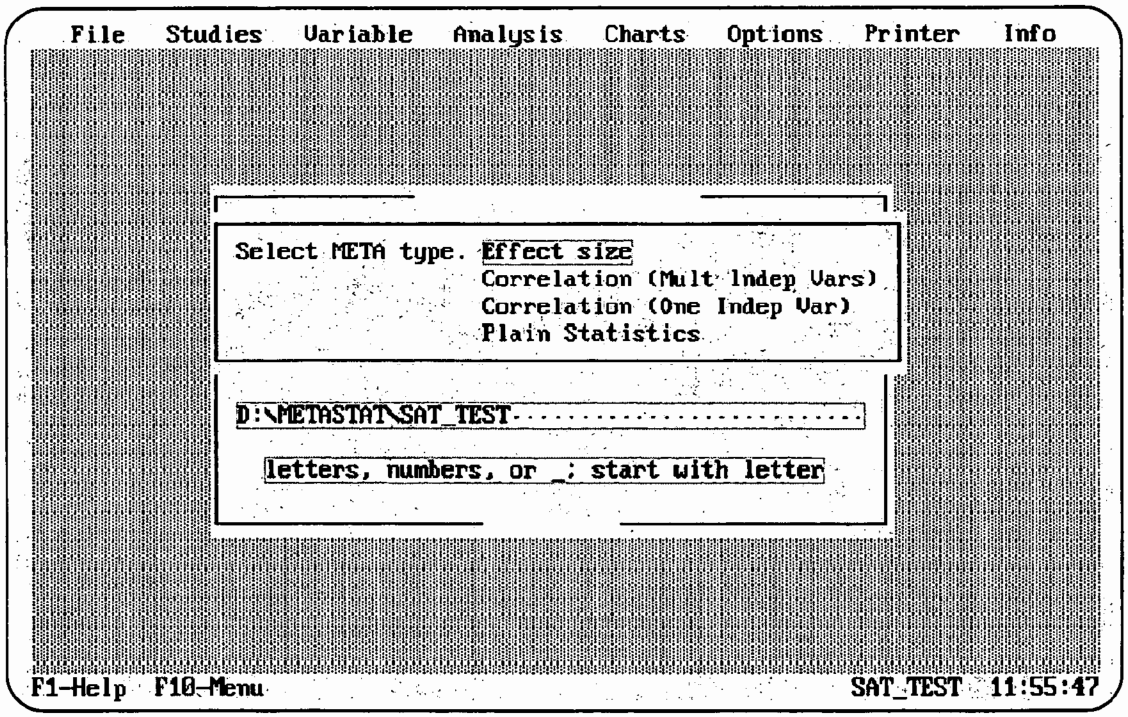
   The name should also follow normal DOS file-naming rules:

   - Use numbers, letters, and the underline character.
   - Do not use punctuation such as the period or comma.

   In the following example, the meta-file is called **SAT_TEST**:

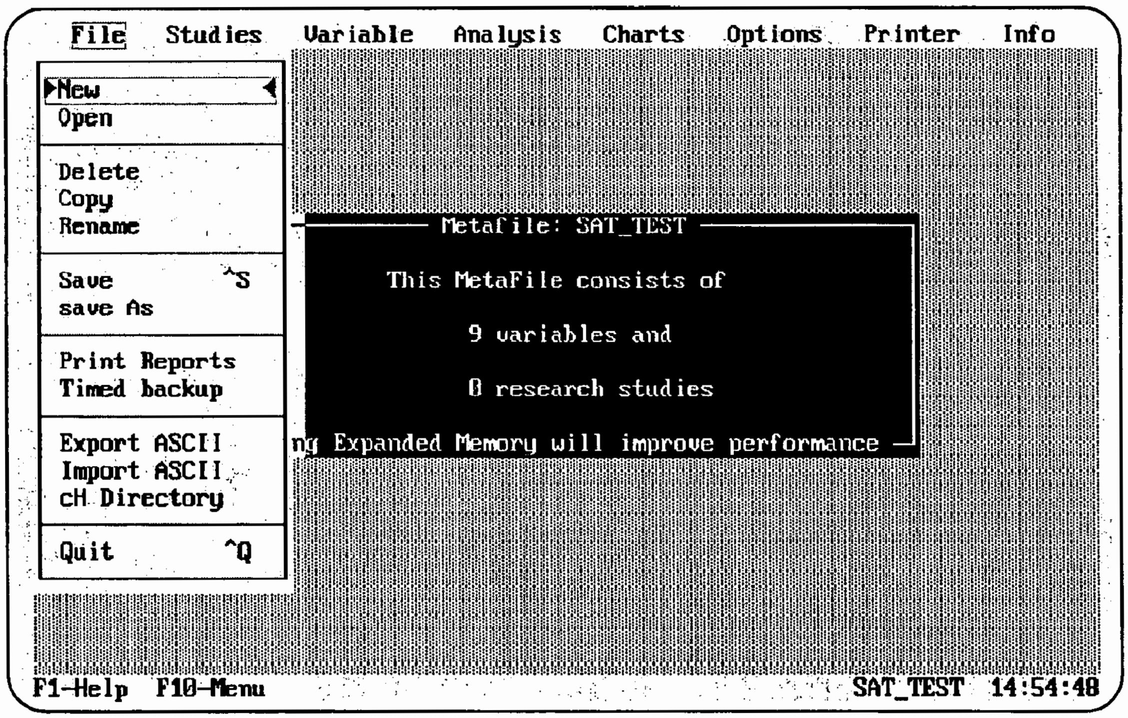


4. Select the type of meta-analysis you are performing, **Effect Size** or **Correlation**.



5. ***Meta-Stat*** displays the name of the meta-file, along with the number of variables and studies in it.

   Meta-Stat automatically creates some variables for you. *See Chapter 4 for more information.*



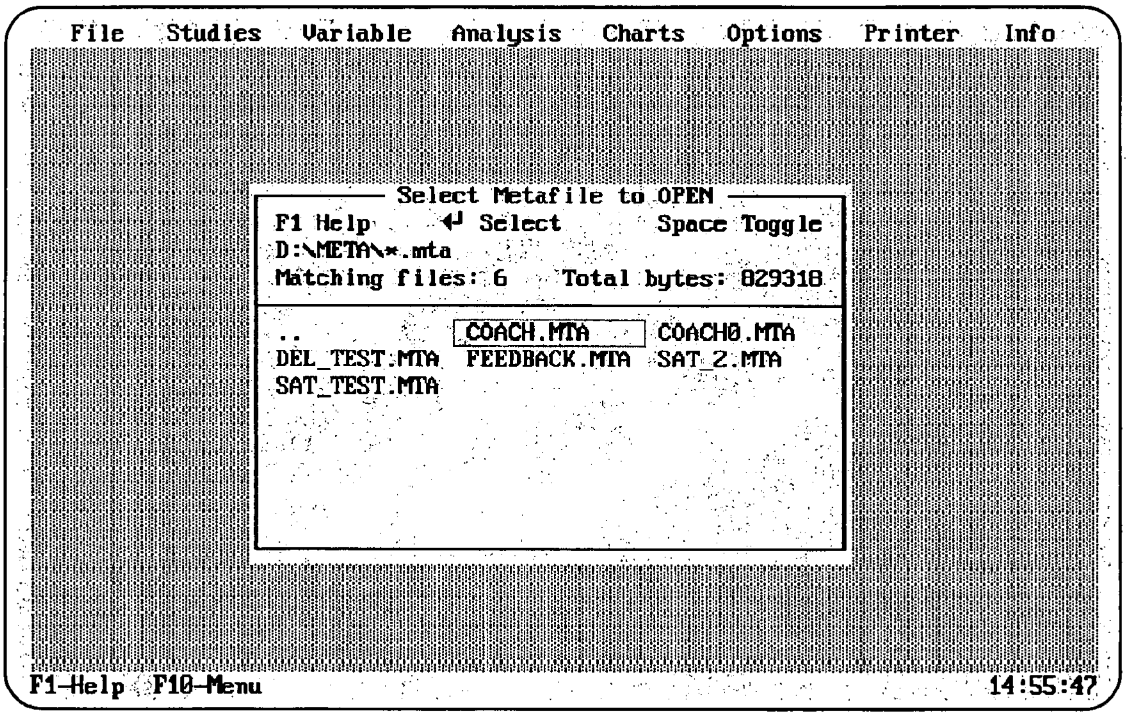
Opening an Existing Meta-File

When you want to work with an old meta-file, you must open it. Follow these steps:

1. Select **File/Open**
2. If necessary, close any open meta-file by following these steps:
3. Select the meta-file you want to open. If necessary, change the directory where the meta-file is stored. See the following sections for more information.

Selecting the Meta-File

1. After you select **File/Open**, *Meta-Stat* displays a list of meta-files in the current directory:



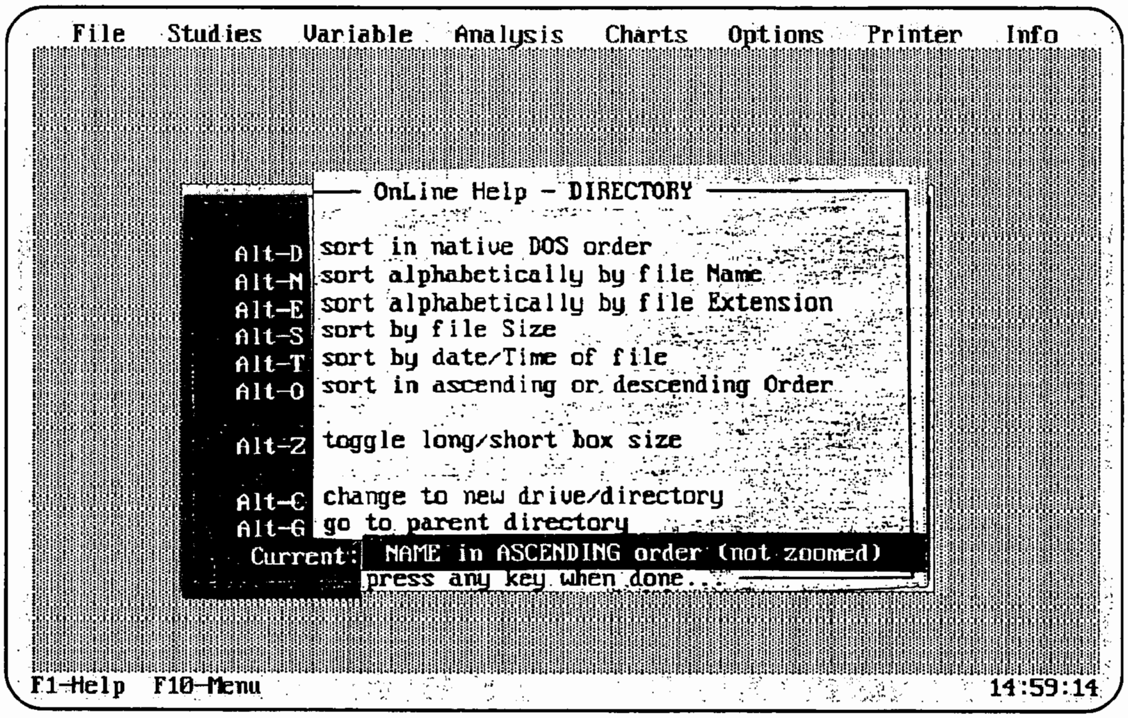
2. If necessary, press **Space** to display the sizes of the meta-files in the current directory, along with the date and time when they were last changed:

```
  File   Studies   Variable   Analysis   Charts   Options   Printer   Info

            ─────────── Select Metafile to OPEN ───────────
            F1 Help           ↵ Select              Space Toggle
            D:\META\*.mta
            Matching files: 4                 Total bytes: 829318
            ─────────────────────────────────────────────────────
            ..              <DIR>    May 27,1993    11:27a
            COACH.MTA       48030    Jun 16,1993     6:56a     A
            COACH0.MTA      48030    Jun 16,1993     9:30a     A
            FEEDBACK.MTA    92858    Jun 16,1993     6:56a     A
            SAT_Z.MTA      640400    May 12,1993    10:12a     A

F1-Help  F10-Menu                                                14:58:38
```

3. Press **F1** to display a list of commands available for sorting the list of files:

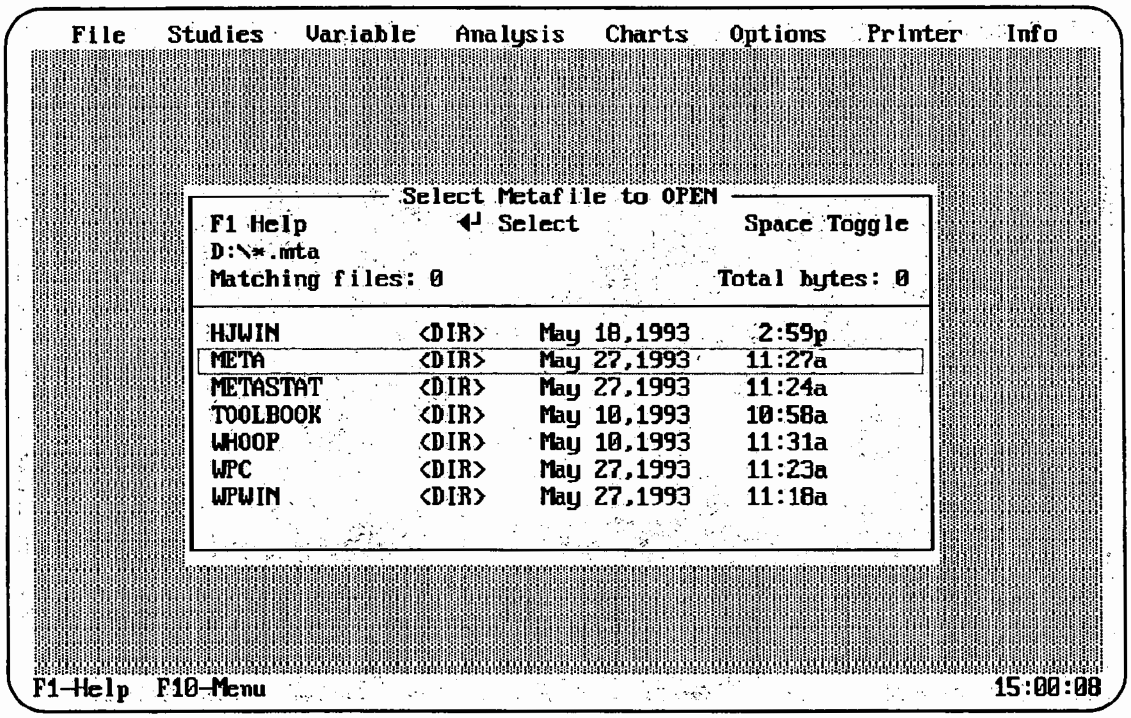


4. Press any key to return to the list of files.
5. To select a meta-file, use the **cursor** keys to highlight the file, then press **Enter**.

Changing the Directory

If necessary, you can change the directory from which ***Meta-Stat*** displays the list of meta-files.

1. Press **Alt-G** to display the parent directory:



NOTE: Instead of pressing **Alt-G**, you can display the parent directory by moving the cursor to the **..** in the directory list and pressing **Enter**.

2. In the list of directories, use the **cursor** keys to highlight the directory, then press **Enter**.

3. In the directory you selected, pick the meta-file you want to open. See the previous section for more information.

Saving a Meta-File

When you change a meta-file by adding variables and studies, ***Meta-Stat*** keeps track of the changes in your computer's memory. However, ***Meta-Stat*** does not automatically save your changes on disk. Therefore, you should make sure that you save your changes on disk—either periodically or when you exit.

You can save the open meta-file using its existing name, or you can save it under a new name. The following sections describe your options.

Saving Periodically

To protect yourself from losing data during a power failure or other problem, you should save the open meta-file periodically.

Select **File/Save** (^S) to save the open meta-file.

When you use **File/Save**, ***Meta-Stat*** uses your backup files to save any changes. When you exit ***Meta-Stat***, you must again tell ***Meta-Stat*** to save changes. This makes your changes permanent, because ***Meta-Stat*** saves them in your original meta-file. If you do not save when you exit, your original meta-file is not updated with the additions and changes made during the session.

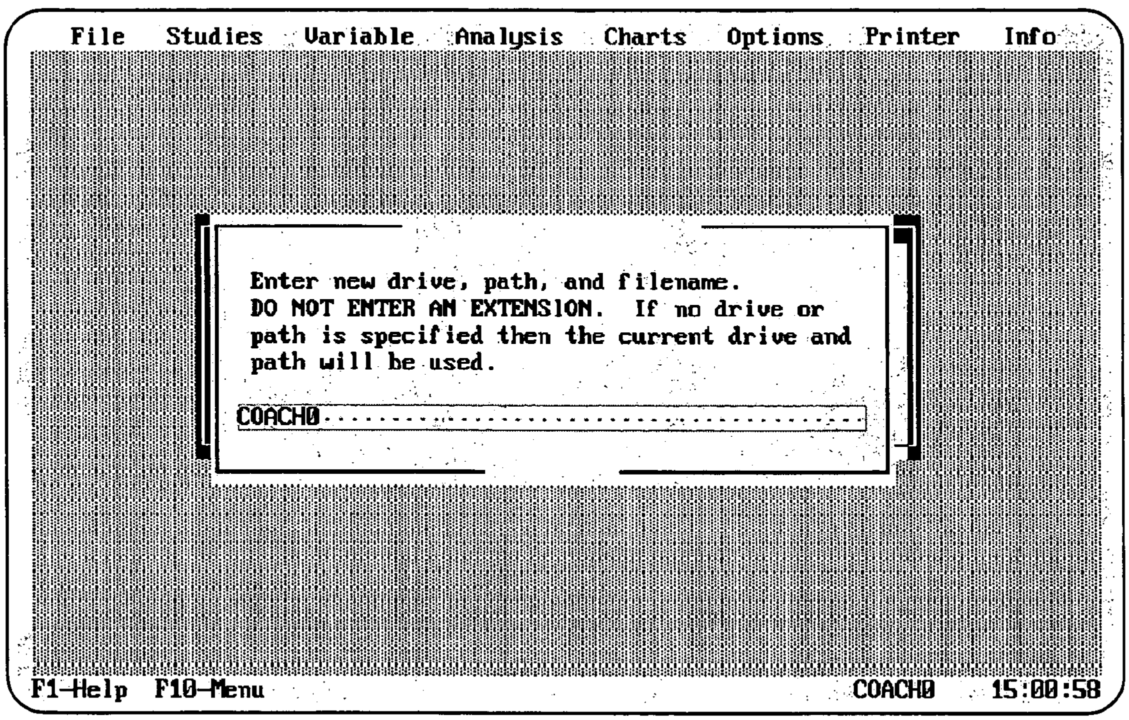
NOTE: You can also use the ***Meta-Stat*** timed backup feature to protect yourself from data losses. For more information, see the section "Keeping Backups of Your Data" later in this chapter.

Saving Under a New Name

You can save a meta-file under a new name. Follow these steps:

1. Select **File/Save As**

   Meta-Stat prompts you to name the new file:

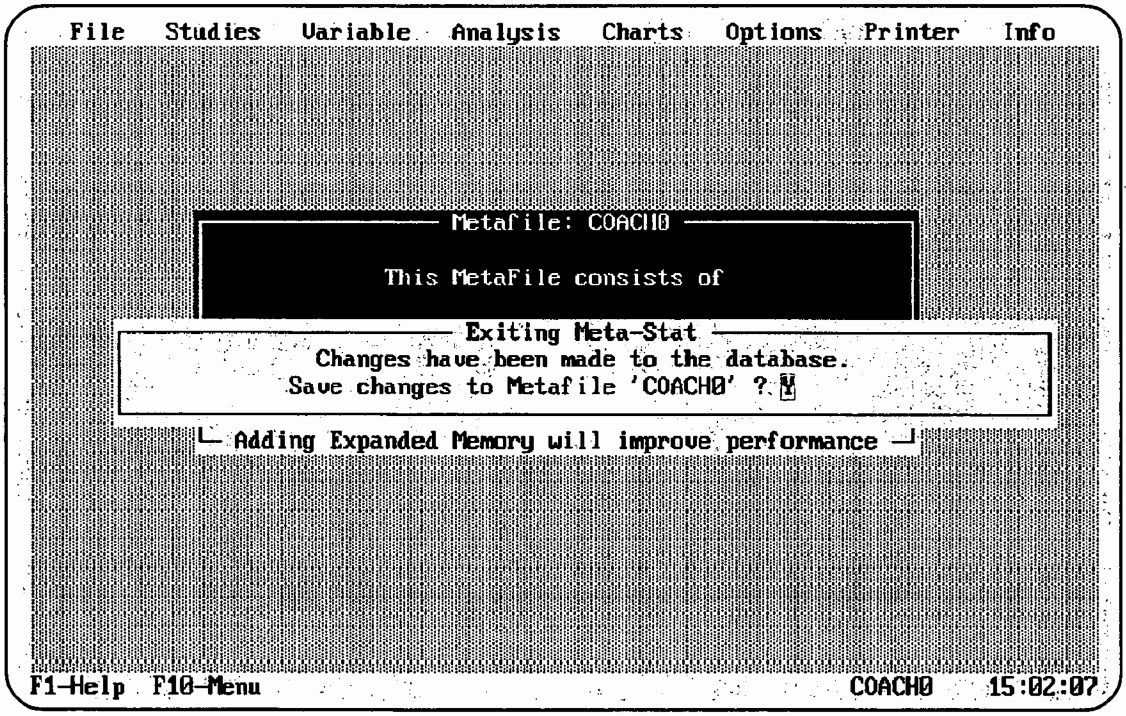


2. Type a new name for the file, then press **Enter**.

   You can precede the file name with a drive and directory path, if necessary, e.g. **a:\DATA\COACH2.** If you do not, *Meta-Stat* saves the file in the current directory.

Saving When You Exit

When you exit, ***Meta-Stat*** prompts you to save the changes to your data:



If you do not save changes, ***Meta-Stat*** does not update your original files with *any* of the changes you made during the session.

Press **Y** to save your changes.

Copying, Deleting, and Renaming a Meta-File

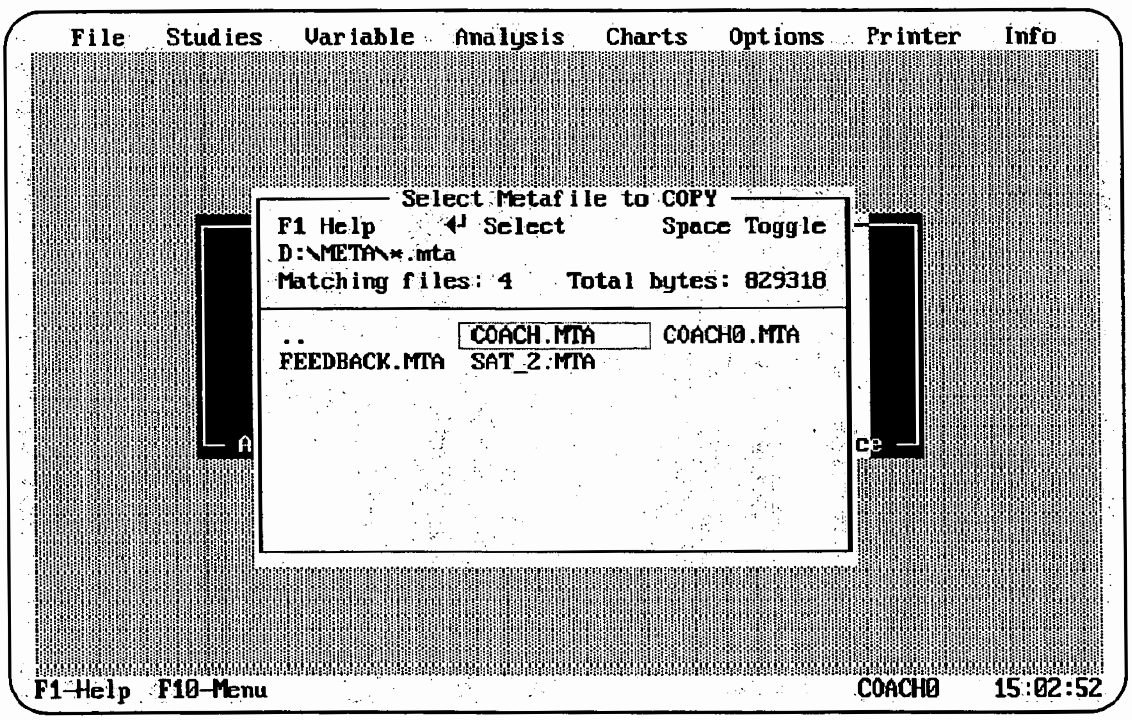
You can do many file-management chores directly within ***Meta-Stat***. You can:

- Copy a meta-file
- Delete a meta-file you no longer need
- Rename a meta-file

Copying a Meta-File

1. Select **File/Copy**

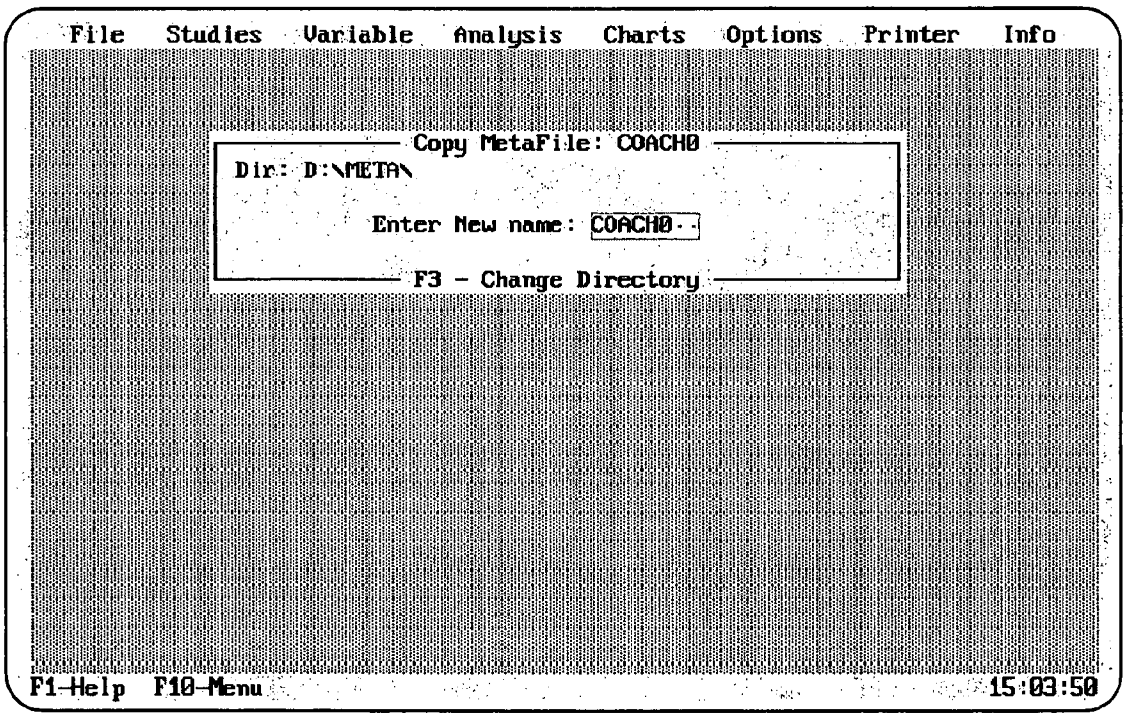
   Meta-Stat prompts you to select the file you want to copy:



2. If necessary, first select the directory in which the file is located. For more information, see the section "Changing the Directory" earlier in this chapter.

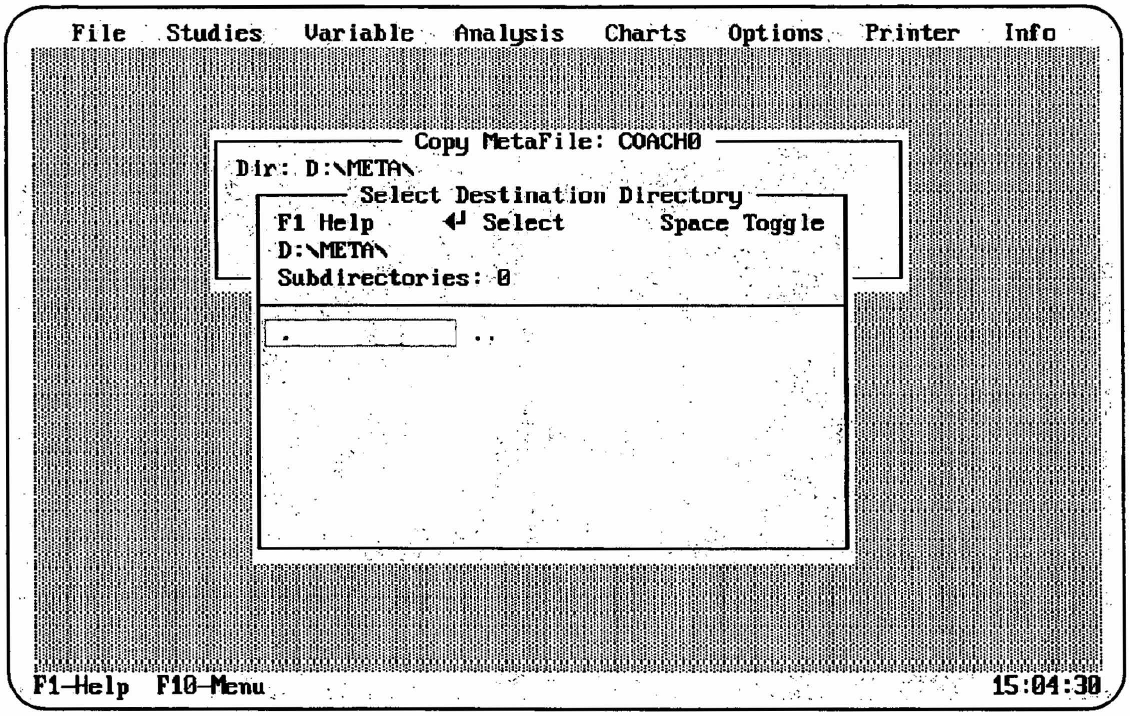
3. Use the **cursor** (arrow) keys to highlight the file, then press **Enter**.

   Meta-Stat prompts you to identify the name of the new file:



4. To change the directory where the copy will be located:

   a. Press **F3** to display this screen:



   b. Move the cursor to the **..** and press **Enter**.

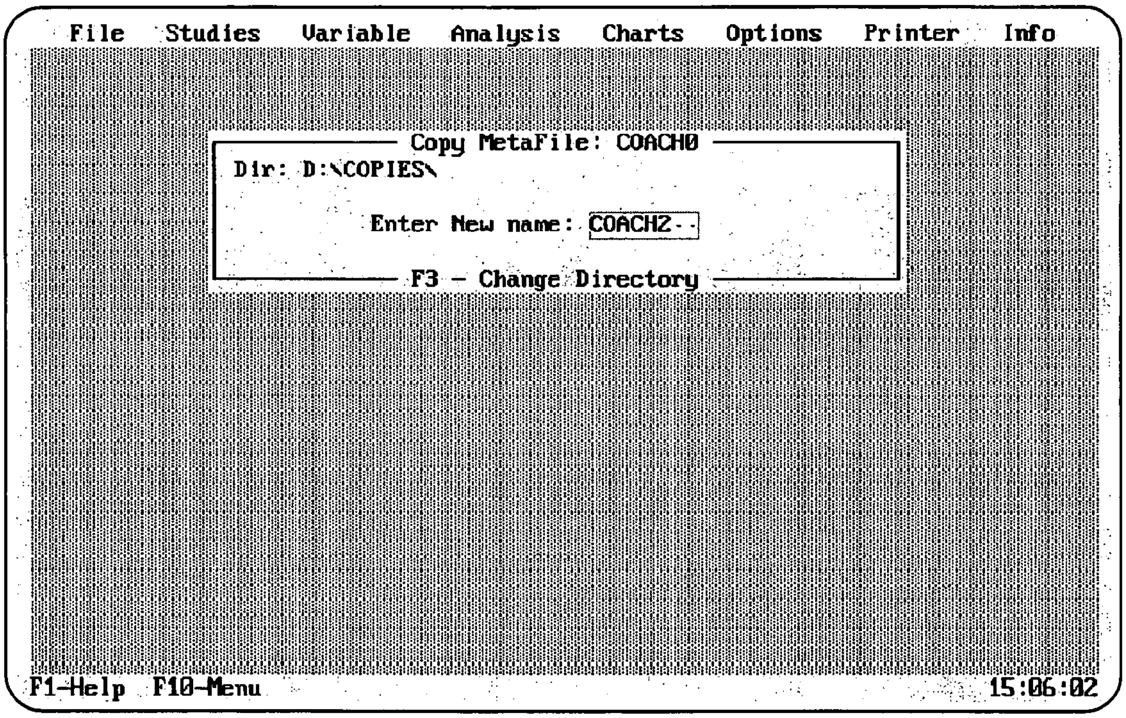
      Meta-Stat displays a list of directories.

   c. In the list of directories, use the **cursor** keys to highlight the directory, then press **Enter**.

   d. Move the cursor to the **.** and press **Enter**.

      Meta-Stat again prompts you to identify the name of the new file.

5. Type the filename. In the following example, a meta-file called **COACHO** is being copied to a directory called **COPIES**. The name of the copied filed is **COACH2**:



Deleting a Meta-File

You can delete a meta-file that you no longer need.

Warning: *Meta-Stat* deletes all files associated with the meta-analysis, including backup files.

Follow these steps:

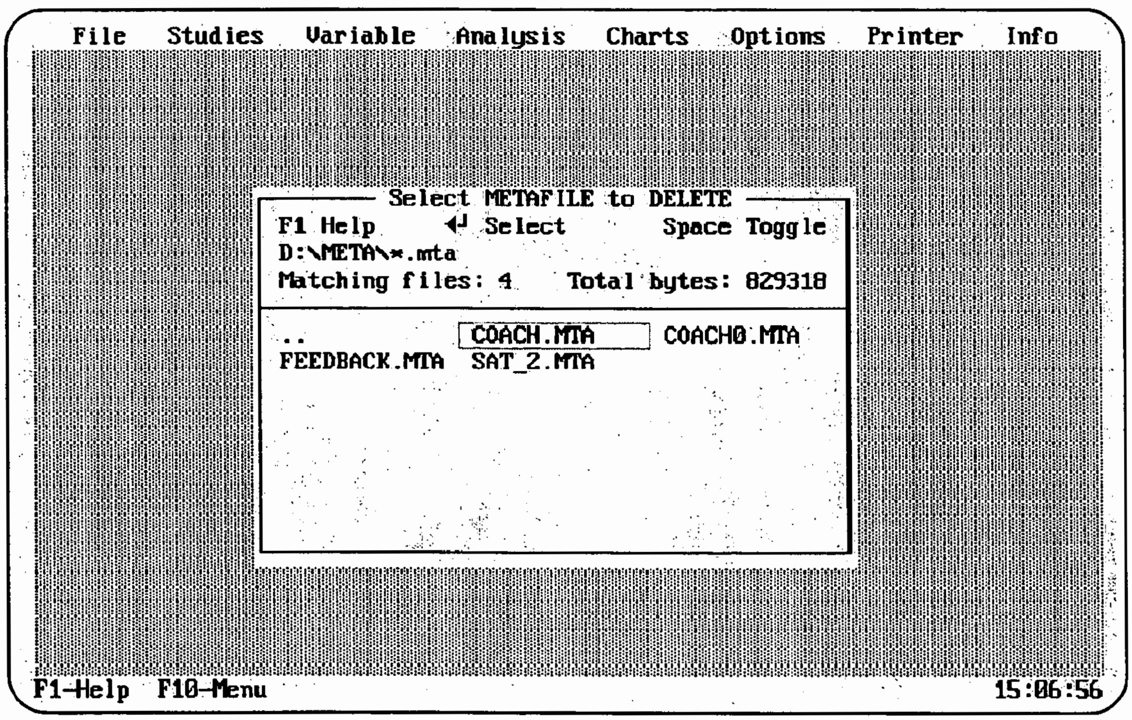
1. Select **File/Delete**

   Meta-Stat prompts you to select the file you want to delete:

2. If necessary, first select the directory in which the file is located. For more information, see the section "Changing the Directory" earlier in this chapter.

3. Use the **cursor** keys to highlight the file, then press **Enter**.

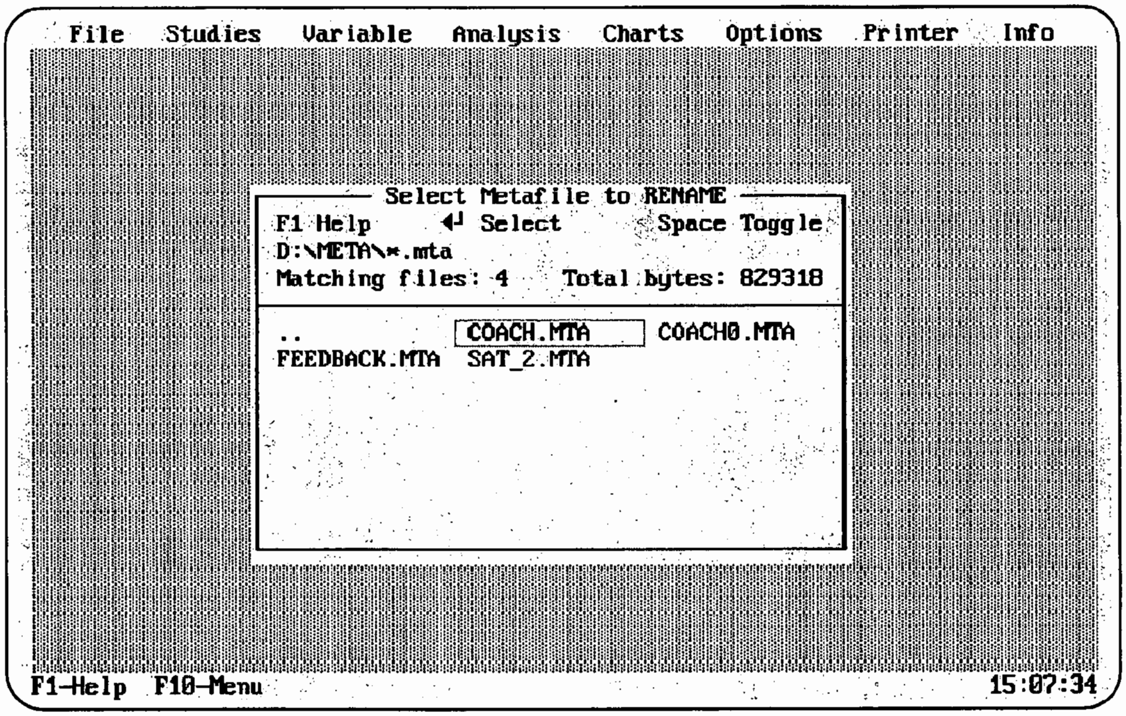
   Meta-Stat asks you to confirm the deletion. Press **Y** or **N**.



Renaming a Meta-File

1. Select **File/Rename**

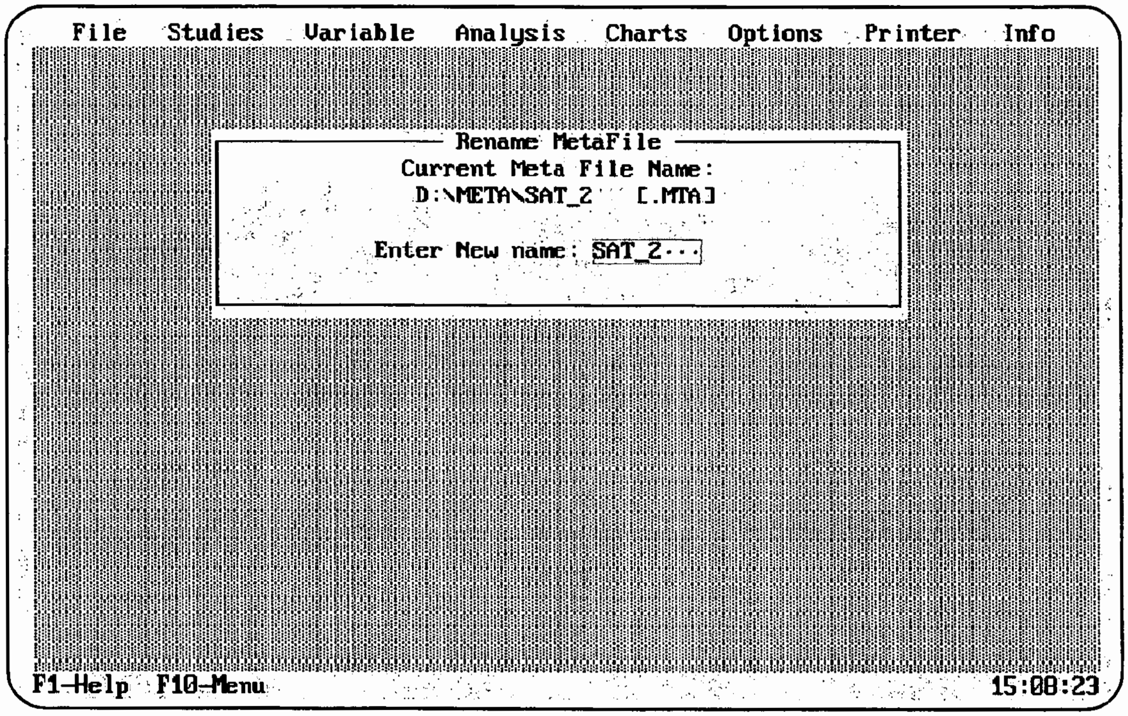
   Meta-Stat prompts you to select the file you want to rename:



2. If necessary, first select the directory in which the file is located. For more information, see the section "Changing the Directory" earlier in this chapter.

3. Use the **cursor** keys to highlight the file, then press **Enter.**

   Meta-Stat prompts you to identify the new name for the file:



4. Use the editing keys **Del, Ins,** and **Backspace** to remove and insert characters in the file name.
5. Press **Enter** when you have finished.

Keeping Backups of Your Data

When you start ***Meta-Stat*** and open a meta-file, the program makes a backup copy of your data.

The following sections show you how to make more frequent backups, and how to recover data from backup copies.

Description of Backup Files

A meta-file actually consists of two files:

- A **definitions file** contains the variables you have defined. This file is named:

  <*meta-name*>.DEF

- A second file contains **study data**. This file is named:

  <*meta-name*>.MTA

The <*meta-name*> is the name you gave to the meta-analysis. The filename extension, DEF or MTA, is assigned by ***Meta-Stat***.

When ***Meta-Stat*** creates a backup copy of your data, it copies the two files described above and changes the filename extensions. The following table describes the backup files:

Name of Backup File	**Contents**
<*meta-name*>.DE!	Copy of <*meta-name*>.DEF
<*meta-name*>.MT!	Copy of <*meta-name*>.MTA

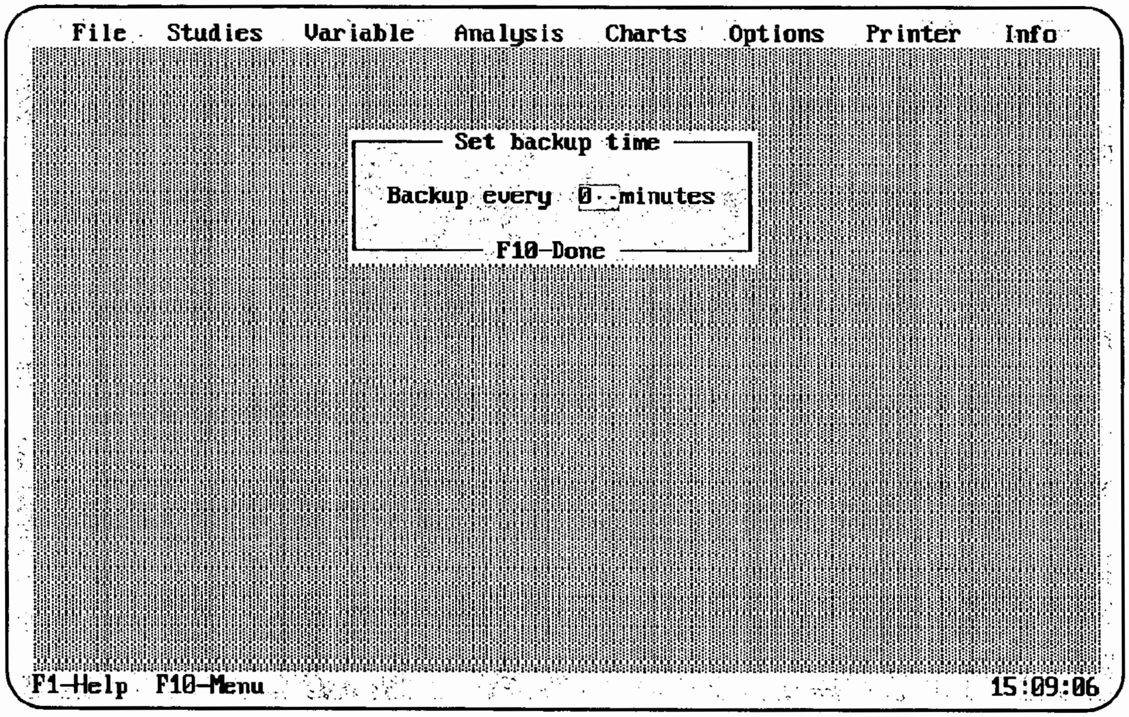
Creating Backup Files Frequently

Meta-Stat creates backup files whenever you start the program and open a meta-file. You can also create backup files more frequently, by using a timed backup feature. You might want to do this when you need to make numerous changes during a ***Meta-Stat*** session.

Follow these steps to use the timed backup feature:

1. Select **File/Timed Backup.**

   Meta-Stat prompts you to identify how often you want to make backups:



2. Type a number from 0 to 999. This is the number of minutes after which ***Meta-Stat*** will create a backup of your meta-file. Select 0 minutes to turn off the timed back-up feature.

3. Press **F10** when you have finished.

Recovering Data from Backup Copies

Sometimes, you might want to discard the data in your current ***Meta-Stat*** data files and instead use the data in your backup files. For example:

- Your current files might be damaged.
- You might want to discard recent changes to your data by returning to the backup copy that was created before you made the changes.

Follow the steps below to recover data from backup copies. The commands you use in these steps rename your backup files to be the current data files for your meta-analysis.

1. Quit ***Meta-Stat*** and return to the DOS prompt.
2. Type the following command:

   rename <*meta-name*>.DE! <*meta-name*>.DEF

   Replace <*meta-name*> with the name of your meta-file.
3. Press **Enter**.
4. Type the following command:

   rename < *meta-name*>.MT! <*meta-name*>.MTA

   Replace <*meta-name*> with the name of your meta-file.
5. Press **Enter**.
6. Start ***Meta-Stat*** again and open the meta-file.

Keeping Backups on Diskette

To protect important data, you should keep backup copies of the data on diskette. If your hard disk is ever damaged, you can recover your data from the diskette.

To keep backups on diskette, use one of two methods:

- Use the **File/Save As** option to save the meta-analysis on a diskette. See the section "Saving Under a New Name" earlier in this chapter.
- Copy the meta-analysis files,<*meta-name*>.DEF and <*meta-name*>.MTA, to a diskette. Use the **DOS COPY** command to copy the files.

Sharing Data with Other Applications

Meta-Stat includes two features that allow you to share data with other applications:

- The **Export** feature exports your meta-analysis data to ASCII files that can be read by other programs.This is coupled with an **Import** feature which reads meta-analysis data from ASCII files into ***Meta-Stat***.
- A stand-alone utility **M2SPSS.EXE** which can be used to create ASCII data files and fully labeled include files for SPSS. The SPSS utility is discussed in the next section of this manual.

An ASCII file is a text-only file that contains no special formatting. Most programs can read ASCII files.

ASCII Files Used for Importing/Exporting

When you export data from a meta-analysis, ***Meta-Stat*** creates two ASCII files. If you want to import data into ***Meta-Stat***, you must create these ASCII files yourself.

- A **definitions file** contains the variables for the meta-analysis. This file is named *<meta-name>*.ASD
- A second file contains **study data**. This file is named *<meta-name>*.ASM

The *<meta-name>* is the name of the meta-analysis.

Structure of the Definitions File

The definitions file contains variables that are used in the meta-analysis. It has this filename:

<meta-name>.ASD

where *<meta-name>* is the name of the meta-analysis.

Each record (line) in the file identifies a separate variable, and the fields in the record are delimited by commas. Alphanumeric fields are enclosed within quotes.

Field	Contents
1	Numeric identifier of the variable
2	Eight-character name of the variable
3	One-character identifier of the variable's type: B Blocking C Continuous D Discrete E Equation
4	Total length of the variable's data
5	Number of decimal places allowed for the variable's data
6	25-character description of the variable For blocking, continuous, and equation variables, a | separates the description from additional variable information.

The following example shows the contents of a definitions file:

```
1,"EFFECTSZ","C",8,3,"Effect Size"

2,"UNBIASED","E",8,3,"Unbiased Effect Size | (1 - (3 / ((4 *
TOTAL_N) - 9))) * EFFECTSZ"

3,"EFFSR_GP","D",1,0,"Effect size source | 1=Correlation;
2=T-Statistic; 3=F-Statistic; 4=Chi-Square; 5=Probability
Level; 6=Standardized Difference; 7=Direct Entry; 8=Gain
Scores (parametric)"

4,"EFF_CLTR","D",1,0,"Effect size cluster"

5,"PUB_YR","C",2,0,"Publication Year"

6,"EXP_N","C",10,0,"Experimental Group Size"

7,"CTRL_N","C",10,0,"Control Group Size"

8,"TOTAL_N","E",10,0,"Total Sample Size | EXP_N + CTRL_N"

9,"WEIGHT","E",8,3,"Inverse of the variance |
(2*TOTAL_N*EXP_N*CTRL_N) / ((2*SQR(TOTAL_N)) +
(EXP_N*CTRL_N*SQR(UNBIASED)))"
```

Structure of the Study-Data File

The study-data file contains study data. It has this filename:

<meta-name>.ASM

where *<meta-name>* is the name of the meta-analysis, up to eight characters long.

Each record (line) in the file identifies a separate study, and the fields in the record are separated by commas. Alphanumeric fields are enclosed within quotes.

NOTE: Missing data—that is, a variable for which no value is available—are identified by -999999.

The table below shows the structure of the study-data file:

Field	Contents
1	Eight-character name of the study
2	Authors of the study
3	Title of the study
4-end	Data for each variable, separated by commas. The record ends with a carriage return - line feed. Missing data are identified by -999999

The following example shows the contents of a study-data file:

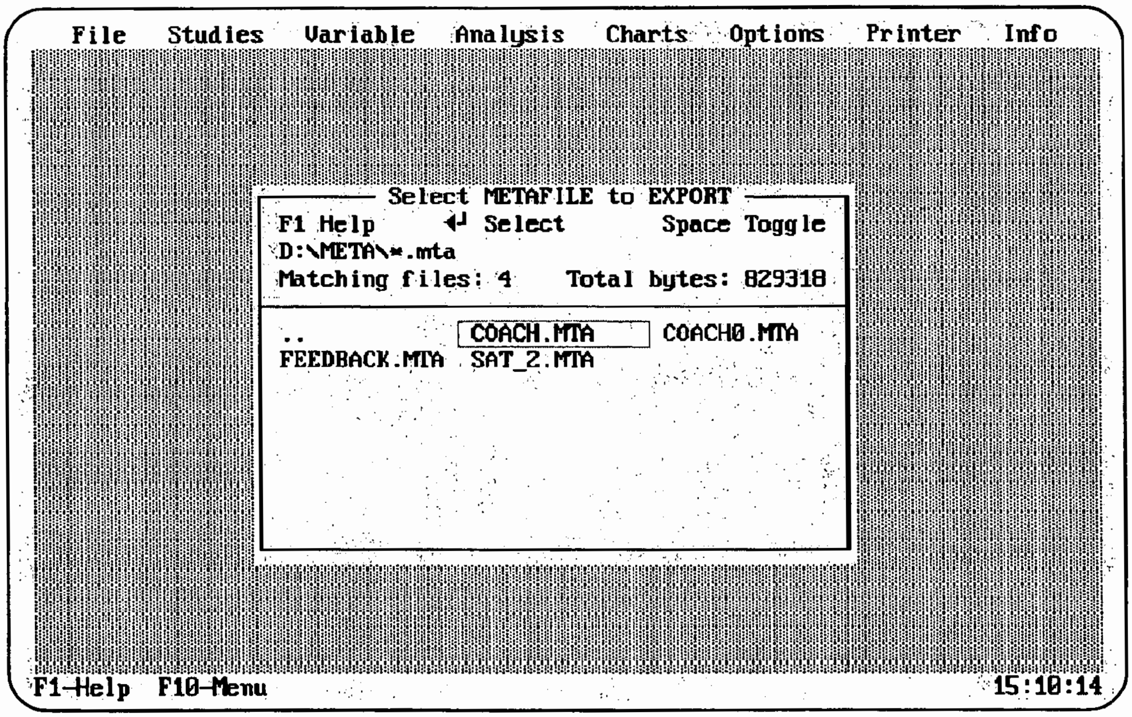
```
"ALLEN","Allen, G. J.","Effectiveness of study
counseling",0.918,0.909,2,0,67,41,40,81,18.351,2,-999999.00,-
999999,14,3,2,1,4,1,-999999.0,0.0,-999999,-999999, 0.0,0.909
"BAJTEL1","Bajtelsmit, J. W.","Test-wiseness and systematic
desensitization",2.50,-999999.000,7,0,68,-999999,-999999,-999
999,-999999.000,5,2.50,3,16,3,2,1,4,1,999999.0,0.0,-999999,-9
99999,0.92,0.000
"BAJTEL2","Bajtelsmit, J. W.","Test-wiseness and systematic
desensitization",0.50,0.490,7,0,72,-999999,25,40,9.118,-99999
9,1.00,2,6,1,2,2,4,2,-999999.0,0.0,-99999,-999999,0.60,0.000
"BAJTEL3","Bajtelsmit, J. W.","Test-wiseness and systematic
desensitization",0.20,0.192,7,0,71,10,10,20,4.977,3,-999999.0
0,-999999,-999999,-999999,2,2,4,2,-99999.0,0.0,-999999,-99999
9,-0.03,0.000
"CALLEN","Callenbach, C.","The effects of instruction and
practice in content", 0200,0.195,7,0,81,15,15,30,7.465,1,
1.00,2,4,1,1,2,4,4,-999999.0,0.0,-999999,-99999,0.51,0.000
```

Exporting a Meta-Analysis

To export a meta-analysis to ASCII files, follow these steps:

1. Select **File/Export ASCII**

   Meta-Stat prompts you to identify the meta-analysis you want to export:



2. Highlight the file you want to export, then press **Enter**.

   If necessary, first select the directory in which the file is located. For more information, see the section "Changing the Directory" earlier in this chapter.

   Meta-Stat creates two ASCII files that hold data from the meta-analysis. For more information about these files, see the section "ASCII Files Used for Importing/Exporting" earlier in this chapter.

Importing a Meta-Analysis

To import data from ASCII files into ***Meta-Stat***, follow these steps:

1. Create the two ASCII files that will be imported. For more information about these files, see the section "ASCII Files Used for Importing/Exporting" earlier in this chapter.

   Warning: Use the extension ASD for the definitions file, ASM for the study-data file. For example:

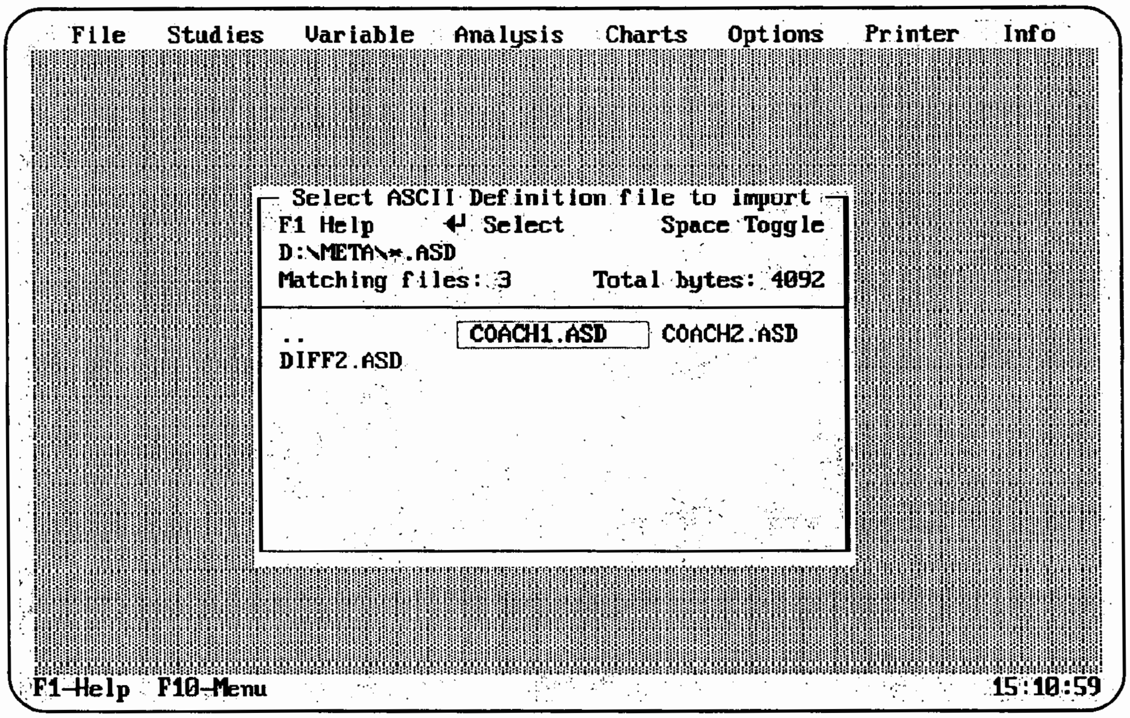
   SAT.ASD
   SAT.ASM

   Make sure that you have not used the same name for an existing meta-analysis. For example, if you already have a meta-analysis called SAT, and you import the two files listed above, ***Meta-Stat*** will overwrite the existing meta-analysis.

2. Start ***Meta-Stat***.

3. Select **File/Import ASCII**

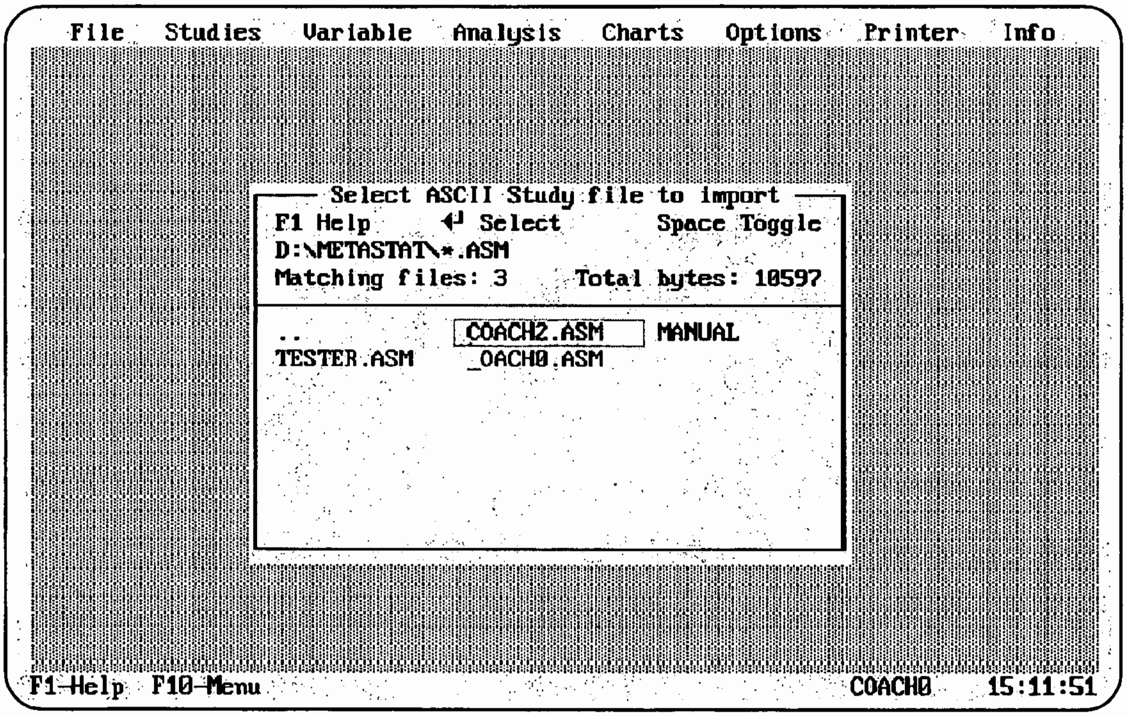
   Meta-Stat prompts you to identify the definitions file. This is the file that contains variables:



4. Highlight the definitions file you want to import, then press **Enter**.

   If necessary, first select the directory in which the file is located. For more information, see the section "Changing the Directory" earlier in this chapter.

5. If your study-data file has a different name from the definitions file, ***Meta-Stat*** prompts you to identify the study-data file:



6. Highlight the study-data file, then press **Enter**.

   Meta-Stat imports the files and creates a meta-analysis.

Converting a Meta-Analysis for SPSS

Meta-Stat can convert the data from your meta-analysis into two files for use with SPSS (Statistical Package for the Social Sciences). Follow these steps:

1. Change to the directory where you installed *Meta-Stat*.

2. Type this command from the DOS prompt:

   M2SPSS <meta-analysis>

   where **<meta-analysis>** is the name of the meta-analysis you have created with *Meta-Stat*.

3. Press **Enter**.

   Meta-Stat creates two output files: **<meta-analysis>.INC** contains variable definitions (referred to as an 'Include file' by SPSS), and **<meta-analysis>.DAT** contains study data.

4. Check your screen for errors. The most common error occurs when the .INC file refers to a variable that is not defined until later in the file. Use your word processor to move the variable definition before the offending error.

5. Use the two files as input to SPSS. Consult your SPSS documentation for more information.

The .DAT file contains the data for all the variables in your meta-file, including the data derived from equations and blocking variables. If you are missing **CTRL_N** and **EXP_N**, for example, but have recorded **TOTAL_N**, M2SPSS will use your value in recording **TOTAL_N**, not the equation. Thus, M2SPSS lets you analyze the identical dataset.

The functions used by meta-stat to provide the equation and blocking variable results are also provided in the include file. They are commented out with a leading '* ' so as not to override the recorded values. If you want to use the equations, use your word processor to remove the equations.

5 Working with Variables

Variables are characteristics of the studies in your meta-analysis. ***Meta-Stat*** comes precoded with several variables. You can add other variables specific to your meta-analysis.

This chapter describes how to work with variables.

Types of Variables

You can use four types of variables:

Type	Use When ...	Example
Discrete	The variable will have up to nine values, and you know the values in advance.	A discrete variable called **GENDER** could have the values Male or Female.
Continuous	The variable can have any value.	A continuous variable called **HOURS** could describe the number of hours that subjects received treatment, coaching, or other intervention.

Type	Use When ...	Example
Blocking	The variable will identify up to five groups of data, and the groupings are based on the values of other variables.	A blocking variable could be used to group student grade levels. The variable could contain the values Elem, Middle, and High. Elem Grades 1-5 Middle Grades 7-9 High Grades 10-12 The variable's equations could calculate the values based on a continuous variable that holds the actual grade level (1 to 12).
Equation	The value of the variable should be calculated by *Meta-Stat*, using mathematical operators and other variables.	A precoded variable, **UNBIASED**, uses the sample size and **Effect Size** variables to remove **Effect Size** bias that is caused by a small study sample. See the next page for more information about this variable.

Precoded Variables

Meta-Stat comes precoded with several variables that are used for a typical meta-analysis. The table below describes these variables for effect-size meta-analysis.

Variable	Type	Is Used to Identify ...
EFFECTSZ	Continuous	**Effect Size** from a study, typically the difference between the means of two groups divided by a standard deviation. ***Meta-Stat*** can calculate the value of this variable for you.
UNBIASED	Equation	**Unbiased Effect Size.** This variable's equation uses the sample size (**TOTAL_N**) and the Effect Size (**EFFECTSZ**) to remove **Effect Size** bias that is caused by a small study sample. The equation is: **UNBIASED**= (1 - (3 / ((4 * **TOTAL_N**) - 9))) * **EFFECTSZ**

Variable	Type	Is Used to Identify ...
EFFSR_GP	Discrete	Source of the **Effect Size** value. The variable describes one of eight values. ***Meta-Stat*** fills in the value for you based on your entry for the **Effect Size** variable. Value / Effect Size Source 1 Correlation 2 T-Statistic 3 F-Statistic 4 Chi-Square 5 Probability 6 Standardized 7 Gain Score 8 Direct Entry
PUB_YR	Continuous	Year the study was published.
EXP_N	Continuous	Size of the experimental group.
CTRL_N	Continuous	Size of the control group.
TOTAL_N	Equation	The total sample size. This equation uses the size of the experimental group (**EXP_N**) and the size of the control group (**CTRL_N**) to calculate the total sample size. The equation is: **TOTAL_N** = **CTRL_N**+**EXP_N**
WEIGHT	Equation	The inverse of the variance. This equation uses the values of other variables to calculate a weighting value. The equation is: **WEIGHT** = (2 * **TOTAL_N** * **EXP_N** * **CTRL_N**) / ((2 * sqr(**TOTAL_N**)) + (**EXP_N** * **CTRL_N** * sqr(**UNBIASED**)))
PUB_GP	Discrete	The type of publication in which the study appeared. The variable can hold one of five values: Value / Type of Publication 1 Journal 2 Dissertation 3 Paper 4 Book 5 Other

Creating New Variables

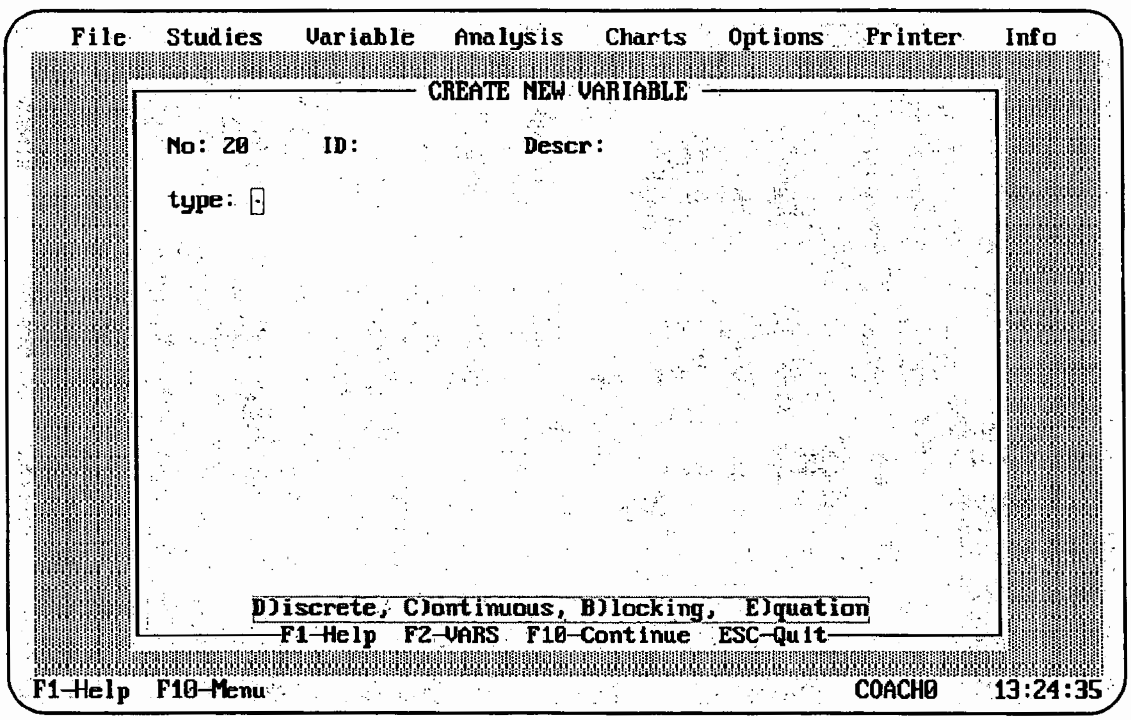
You must create additional variables to describe the data from the studies in your meta-analysis.

Initial Steps for All Types of Variables

No matter which type of variable you want to create, the initial steps are the same:

1. If necessary, create or open a meta-file. *See Chapter 4 for more information.*
2. Select **Variable/New (^N)**

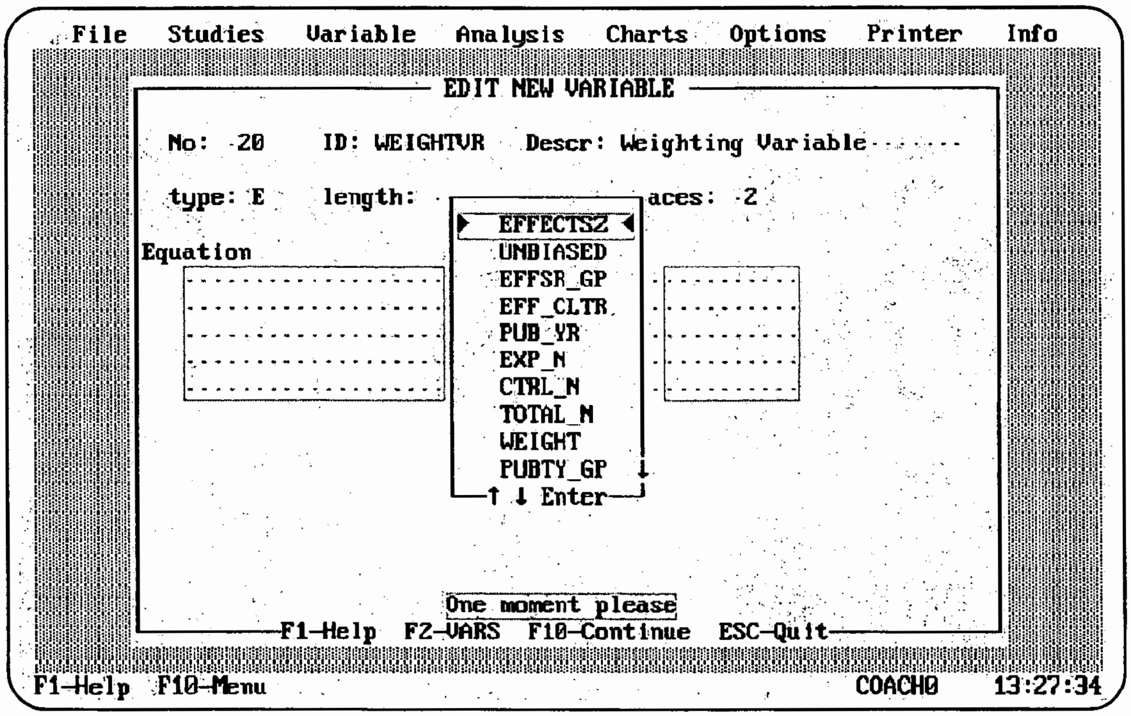
   Meta-Stat displays the following screen:



3. Complete the **type, ID,** and **Descr** fields as shown below:

Field	Enter this ...	Notes
type	A letter to identify the type of variable you are creating: <u>Letter</u> <u>Variable Type</u> B Blocking C Continuous D Discrete E Equation	As soon as you identify the type of variable, ***Meta-Stat*** displays the appropriate screen for that type. The cursor moves to the **ID** field.
ID	An eight-character identifier that: • Begins with a letter • Contains no punctuation or special characters except the underline character (_).	***Meta-Stat*** uses the **ID** to identify the variable on selection screens. Therefore, use a meaningful identifier. Press **Enter** after you complete this field.
Descr	Up to 25 characters to identify the variable.	***Meta-Stat*** uses the description as a label for the variable on screens and reports. Press **Enter** after you complete this field.

4. Press **F2** to see a list of the variables that you have already created for the meta-analysis. For example:



5. Press **F10** when you have finished.

   Meta-Stat saves the new variable and returns you to the Variable menu.

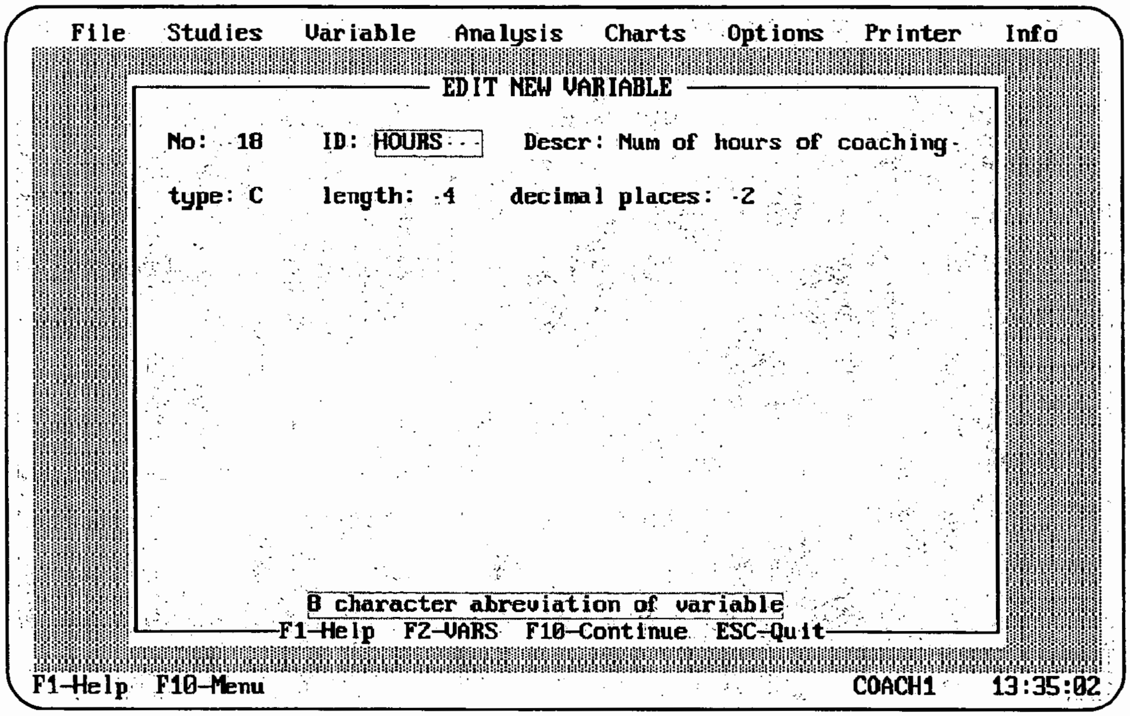
The sections below describe additional steps required for each type of variable.

Creating a Continuous Variable (Type C)

When you create a continuous variable, you must identify the length of data you will input for the variable, including the number of decimal places you want to retain.

Field	Enter this ...	Example
length	A number that identifies the maximum length of data you will enter for the variable, including the decimal point and decimal places.	A length of 6 means that you will enter up to 6 characters total, including a decimal point if any.
decimal places	A number that identifies the number of decimal places you want ***Meta-Stat*** to retain. **NOTE:** ***Meta-Stat*** will round decimals, if necessary, when you perform data entry.	A length of 6 with two decimal places means that you will enter up to 6 characters total, including a decimal point and up to two decimal places—for example: 512.18 615.25 If you enter three decimal places during data entry, ***Meta-Stat*** will preserve the significant digits internally, but will round the decimals to two places for display. For example, 52.896 will be rounded in displays to 52.90.

The following example shows a continuous variable called **HOURS**. The variable has a length of 4, with 2 decimal places:

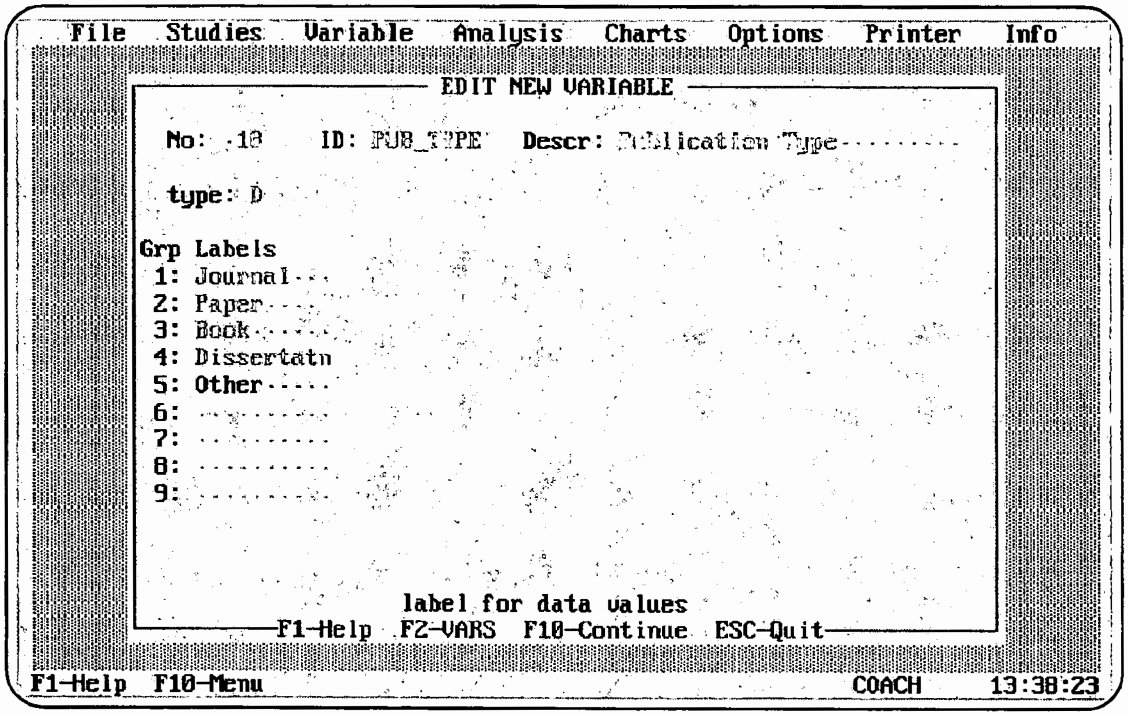


Creating a Discrete Variable (Type D)

Use a discrete variable to handle up to nine values that you know in advance. To assign a value to the variable during data entry, you will enter a number from 1 to 9. ***Meta-Stat*** will then assign the corresponding label.

Field	Enter this ...	Example
Grp	No entry required. The **Grp** value is the value you will enter during data entry.	—
labels	The label that corresponds to the **Grp** value. These are optional.	When creating a variable called Gender, you would use Female for the first **label** and Male for the second **label**. To assign a value during data entry, you would enter 1 to indicate female, 2 to indicate male.

The following example shows a discrete variable called **PUB_TY**. When entering data for this variable, you would enter 1 if the study was published in a journal, 2 if it was published in a paper, and so on:



Creating a Blocking Variable (Type B)

Use a blocking variable when you want to arrange data into groups.

Example of a Blocking Variable

Suppose you have created a continuous variable that will describe the grade level (from 1 to 12) of study participants. You could create a second, blocking variable to assign a group:

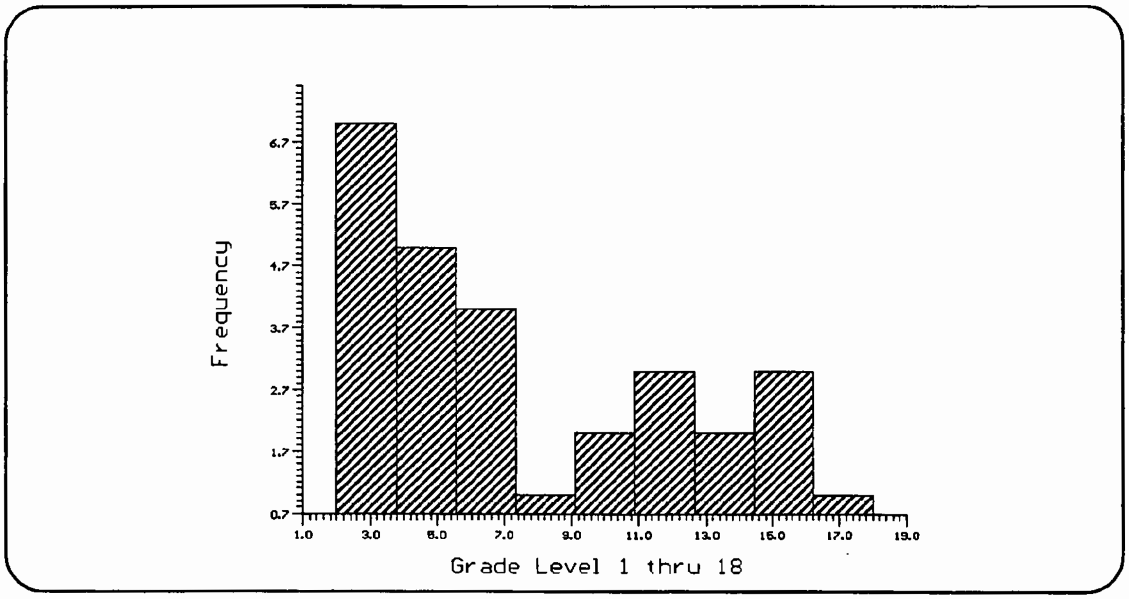
Grade Level (Continuous)	Grade Group (Blocking)
1 2 3 4 5 6	Elem School
7 8 9	Middle School
10 11 12	High School

During data entry, you would enter the grade level of study participants. ***Meta-Stat*** would then use the blocking variable to assign a group.

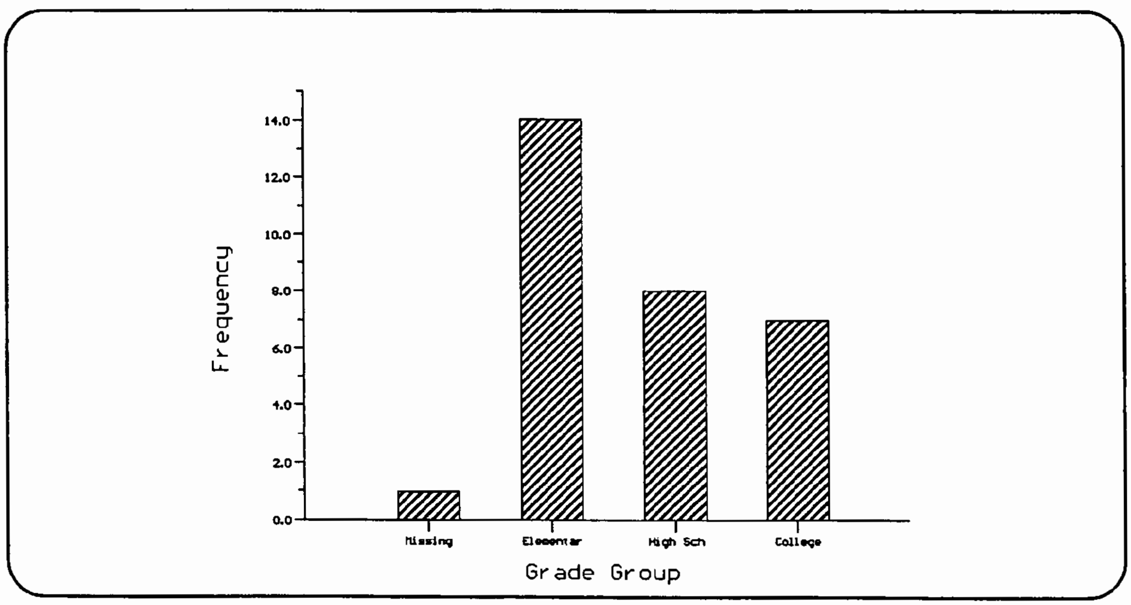
Advantages of Blocking Variables

A blocking variable allows you to preserve your original data (the grade level, in the previous example). At the same time, the variable provides you with meaningful groupings of data that make for cleaner charts and displays.

For example, the following chart was created using grade level as a discrete variable:



This chart, created with the blocking variable, might better suit your purposes:



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Creating a Blocking Variable

When you create a blocking variable, you must specify equations that ***Meta-Stat*** will use to group values. These equations refer to the values of other variables.

The table below shows you how to create a blocking variable.

Field	Enter this ...	Example
Grp	No entry required.	—
labels	A label, up to 10 characters long, to identify the group. This label will be displayed on screens and charts.	A variable called Grade Group might use group labels such as Elem, Middle, and High.
Conditional Equations	The equation that ***Meta-Stat*** will use to group values. For more information, see the notes on equations below.	The equations for the Grade Group variable described above would use the value of a second variable, Grade Level, to assign a value for Grade Group.

When you create equations, be aware of the following:

- You can use the following mathematical operators:

  < > <= >= <> AND OR NOT ( )

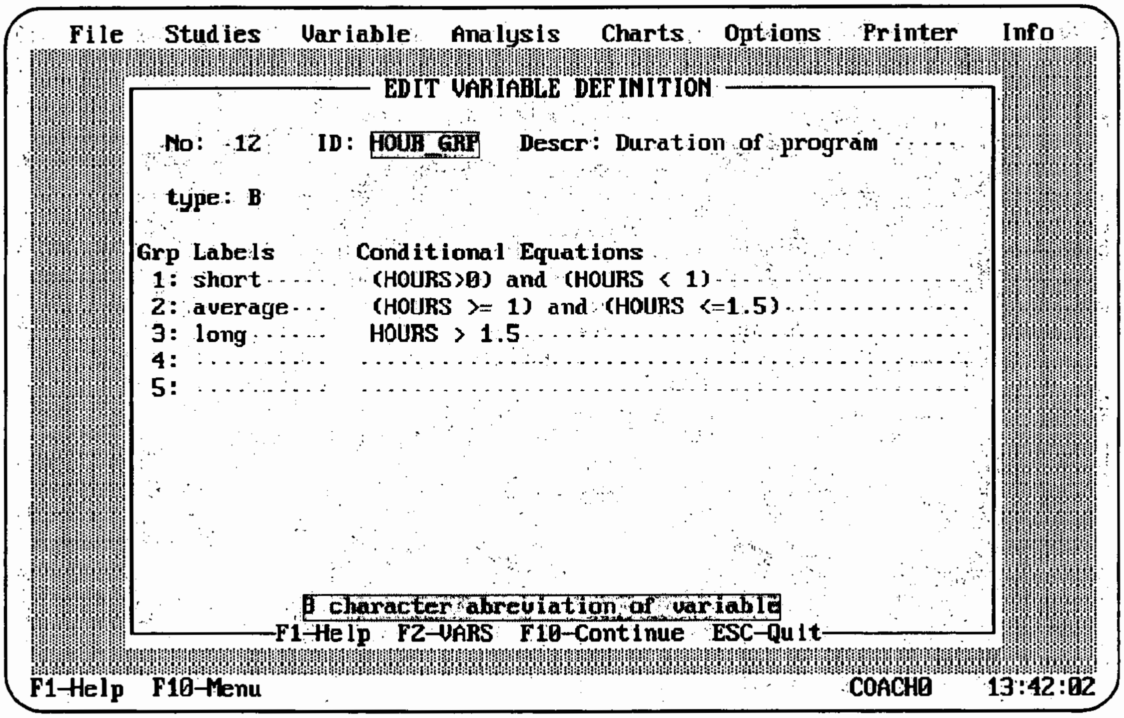
- The equations must refer to variables that you have already created. Press **F2** to display a list of the variables you have already created. You can then select a variable to be inserted into the equation.

- The equation must result in a true or false condition.

The following example shows a blocking variable called **GRD_GP**. To group values, the equations for this variable use a continuous variable called **GRD_LVL**. For example, if the **GRD_LVL** is between 1 and 6, ***Meta-Stat*** will assign a **GRD_GP** value of 1 (Elementary):

```
 File   Studies   Variable   Analysis   Charts   Options   Printer   Info
            ──────────── EDIT VARIABLE DEFINITION ────
         No:  14     ID: GRD_GRP     Descr: Grade Group ............

         type: B

        Grp Labels       Conditional Equations
         1: Elementary    (GRD_LVL >= 1) and (GRD_LVL <= 6)..........
         2: High Sch..    (GRD_LVL >= 7) and (GRD_LVL <= 12).........
         3: College...    (GRD_LVL >= 13) and (GRD_LVL <= 18)........
         4: ..........   ..........................................
         5: ..........   ..........................................




                     8 character abreviation of variable
            ──────F1-Help  F2-VARS  F10-Continue  ESC-Quit──
 F1-Help  F10-Menu                                    COACH0    13:40:53
```

The following example shows a blocking variable called **HOUR_GP**. To group values, the equations for this variable use a continuous variable called **HOURS**. For example, if the value of **HOURS** is greater than 0 and less than 1, ***Meta-Stat*** will assign a **HOUR_GRP** value of 1 (short):



Creating an Equation Variable (Type E)

Use an equation variable to calculate a value based on mathematical operators and other variables.

When you create an equation variable, you must identify the length of data that will be displayed, including the number of decimal places you want to retain.

Field	Enter this ...	Example
length	A number that identifies the maximum length of data that will be displayed, including the decimal point and decimal places.	A length of 6 means a maximum length of 6 characters, including a decimal point if any.
decimal places	A number that identifies the number of decimal places you want ***Meta-Stat*** to display. NOTE: ***Meta-Stat*** will preserve all significant digits but will round decimals, if necessary, for display.	A length of 6 with two decimal places means a length of 6 characters total, including a decimal point and up to two decimal places—for example: 512.18 If the result of the calculation contains three decimal places, ***Meta-Stat*** will preserve all three digits but will round the decimals to two places for display. For example, 52.896 will be rounded to 52.90.
Equation	The equation you want ***Meta-Stat*** to use.	An equation to calculate the total sample size would add the size of the experimental group to the size of the control group.

When you create equations, be aware of the following:

- You can use the following mathematical operators:

  + - * / ( )

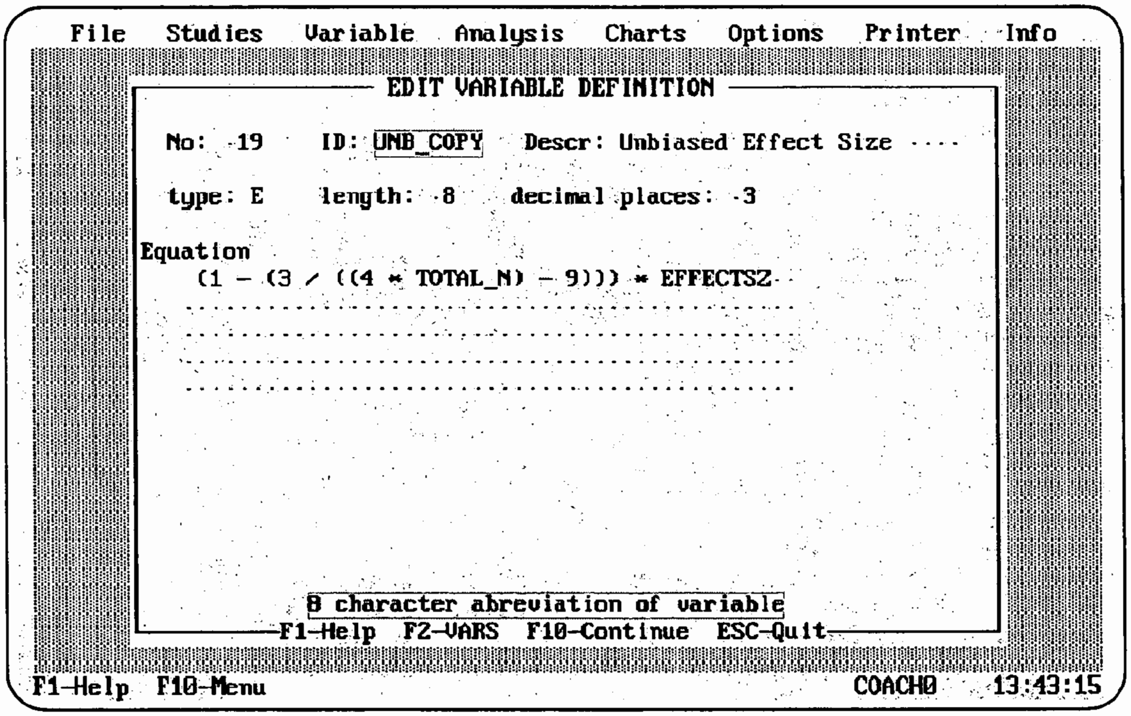
- The equations must refer to variables that you have already created. Press **F2** to display a list of the variables you have already created.

- The equation must result in a real number, so logs or square roots of a negative number are not allowed.

- You can use the following mathematical functions:

Function	Description	Example
ABS	Absolute value	ABS(VAR1)
ATAN	Arctangent, in radians	ATAN(VAR1)
COS	Cosine, in radians	COS(VAR1)
EXP	Exponential	EXP(VAR1)
LN	Natural logarithm	LN(VAR3)
ROUND	Round result to whole number	ROUND(TOT)
SIN	Sine, in radians	SIN(VAR2
SQRT	Square root	SQRT(TOT)
TRUNC	Truncate decimals (whole number without rounding)	TRUNC(TOT)

The following example shows the equation for the **Unbiased Effect Size:**



Changing Your Variables

You can change your variables in different ways. You can:

- Edit a variable

  For example, you might want to change the description of a variable, or change the length of data that you can enter for the variable.

- Copy a variable

  If two variables are similar, you might want to create the first variable, then copy it and edit the copy.

- Delete a variable

If you no longer need a variable, you can delete it.

The following sections describe how to change your variables.

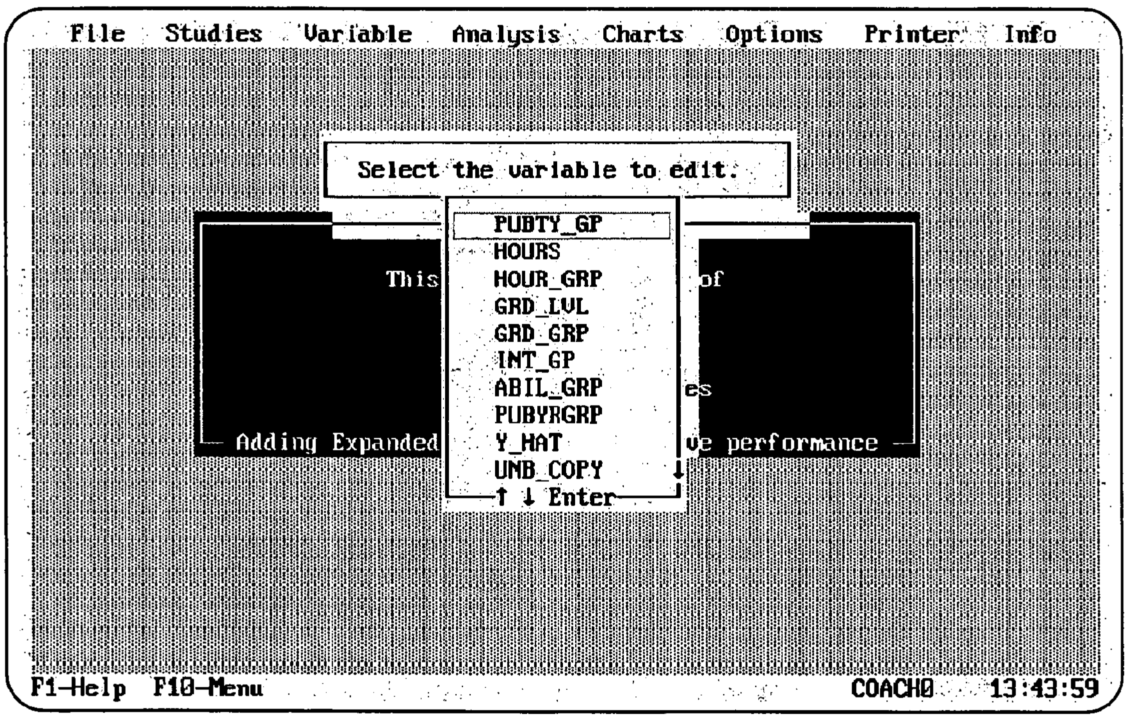
Editing a Variable

You can edit a variable by selecting it from a list, or by highlighting the variable within a study.

Editing by Selecting from a List

1. Select **Variable/Edit (^D)**.

   Meta-Stat displays a list of your variables:



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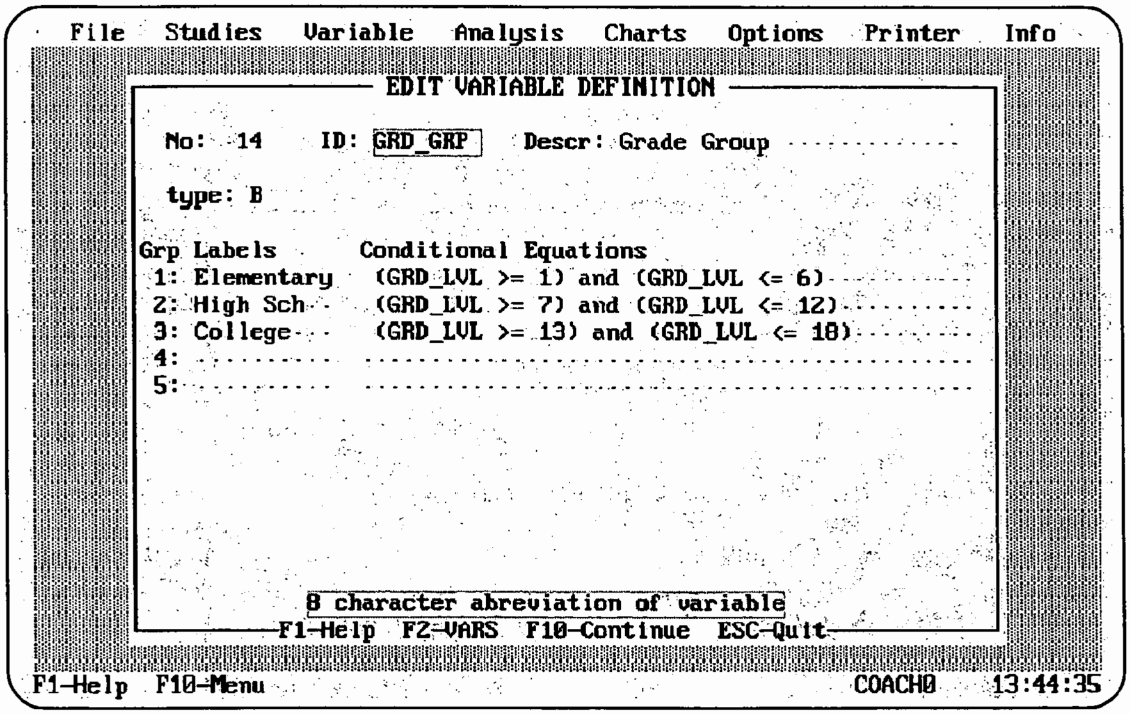
2. Move the cursor to the variable you want to edit, then press **Enter.** ***Meta-Stat*** displays a screen where you can edit the variable:



3. Press **Enter** or **Tab** to move the cursor to the field you want to edit. Then use the editing keys **Del, Ins,** and **Backspace** to edit the field.

4. **Press F10** when you have finished.

Editing by Highlighting a Variable Within a Study

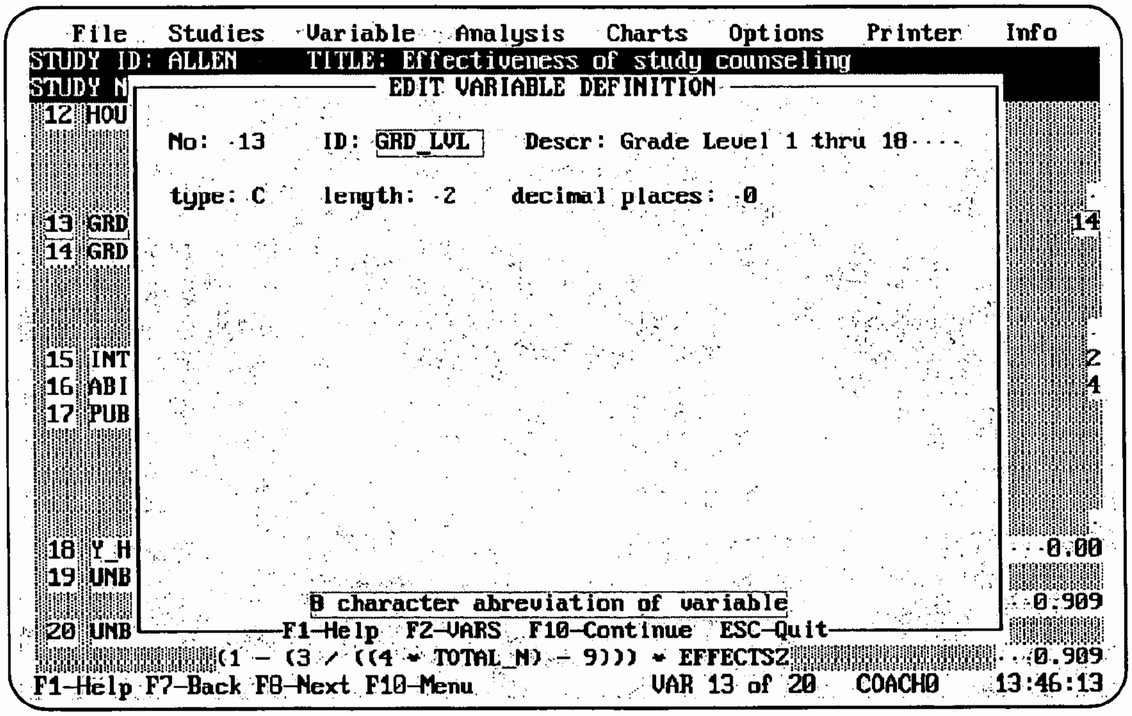
While editing a study, you can go immediately to the editing screen for a variable.

1. Highlight the variable by moving the cursor to it.

   In the following example, the highlighted variable is Variable 13, **GRD_LVL**:

```
  File   Studies   Variable   Analysis   Charts   Options   Printer   Info
STUDY ID: ALLEN       TITLE: Effectiveness of study counseling
STUDY NUM: 1 of 31        AUTHORS: Allen, G. J.
12 HOUR_GRP Duration of program
            1=short: (HOURS>0) and (HOURS < 1)
            2=average: (HOURS >= 1) and (HOURS <=1.5)
            3=long: HOURS > 1.5
13 GRD_LVL  Grade Level 1 thru 18                                        14
14 GRD_GRP  Grade Group
            1=Elementary: (GRD_LVL >= 1) and (GRD_LVL <= 6)
            2=High Sch: (GRD_LVL >= 7) and (GRD_LVL <= 12)
            3=College: (GRD_LVL >= 13) and (GRD_LVL <= 18)
15 INT_GP   Level of intervention | 1=short: 2=test drill: 3=broad        2
16 ABIL_GRP Ability level of subjects | 1=low: 2=middle: 3=high           4
17 PUBYRGRP Year of publication
            1=60-70: (PUB_YR>=60) and (PUB_YR<=70)
            2=71-75: (PUB_YR>=71) and (PUB_YR<=75)
            3=76-80: (PUB_YR>=76) and (PUB_YR<81)
            4=81+: (PUB_YR>80)
18 Y_HAT    Predicted Value                                            0.00
19 UNB_COPY Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ                 0.909
20 UNB_EFFS Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ                 0.909
F1-Help F7-Back F8-Next F10-Menu          VAR 13 of 20   COACH0   13:45:27
```

2. Press **^D** to display the editing screen:



3. Press **Enter** or **Tab** to move the cursor to the field you want to edit. Then use the editing keys **Del, Ins,** and **Backspace** to edit the field.

4. Press **F10** when you have finished.

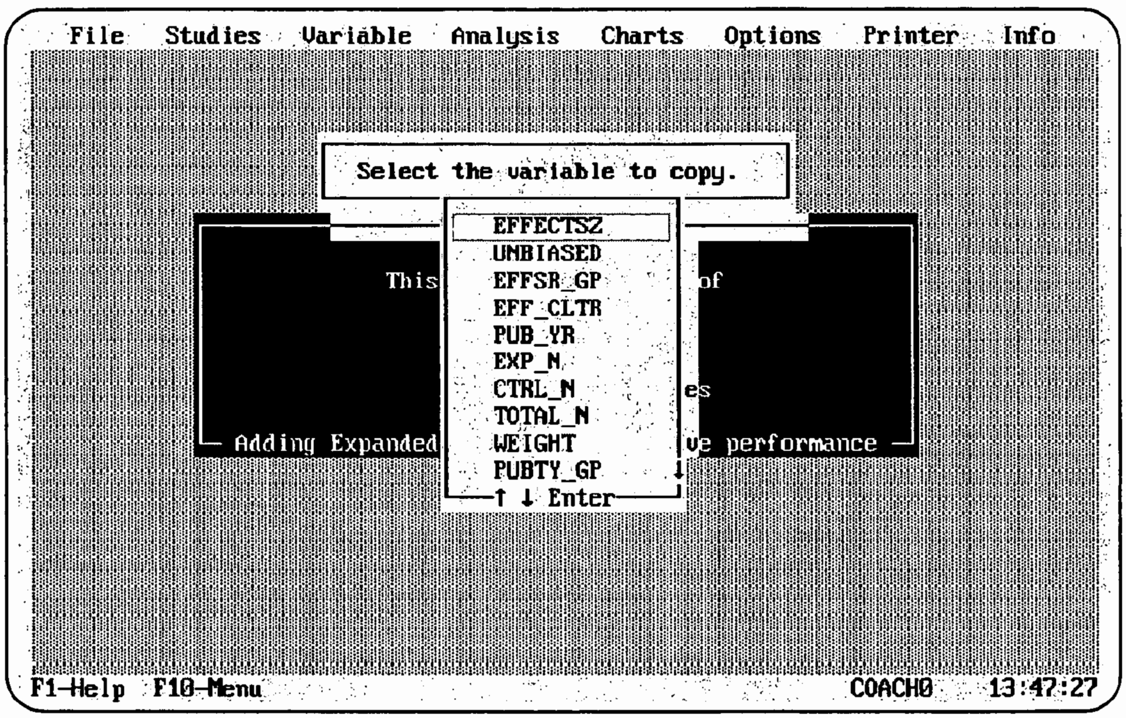
Copying a Variable

If two variables are similar, you might want to create the first variable, then copy it and edit the copy.

Follow these steps to copy a variable:

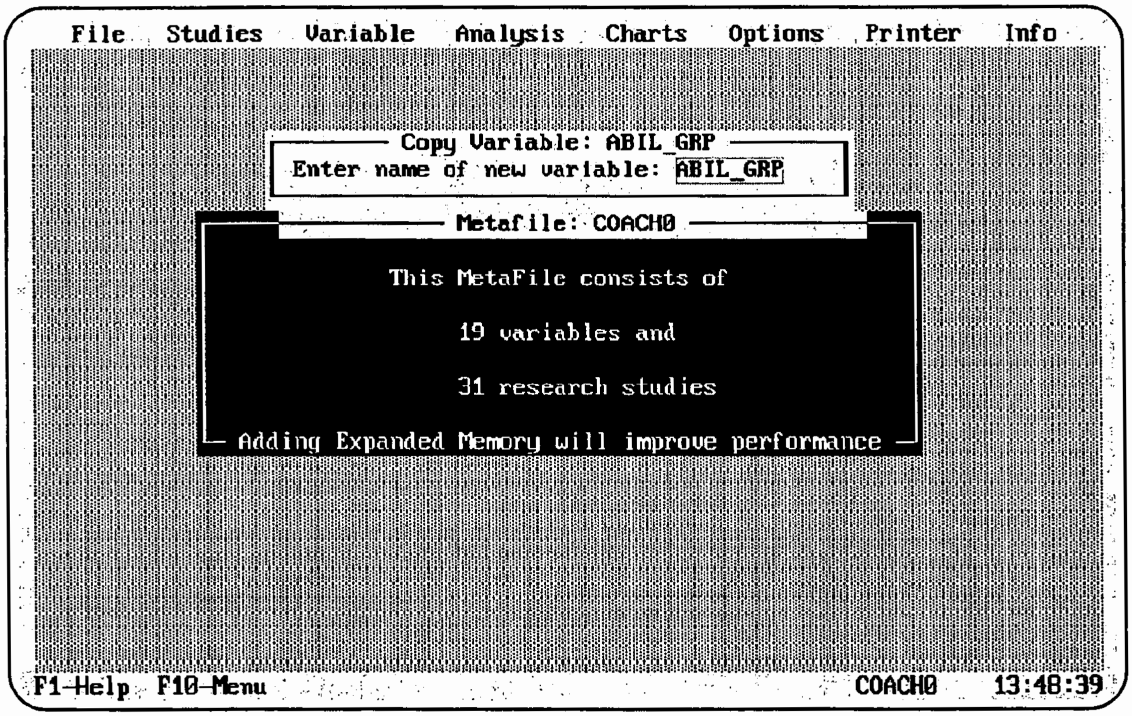
1. Select **Variable/Copy**

   Meta-Stat displays a list of your variables:



2. Move the cursor to the variable you want to copy, then press **Enter**.

   Meta-Stat prompts you for the name of the new variable:



3. Use the editing keys **Del, Ins**, and **Backspace** to create the name of the new variable.

4. Press **Enter** when you have finished.

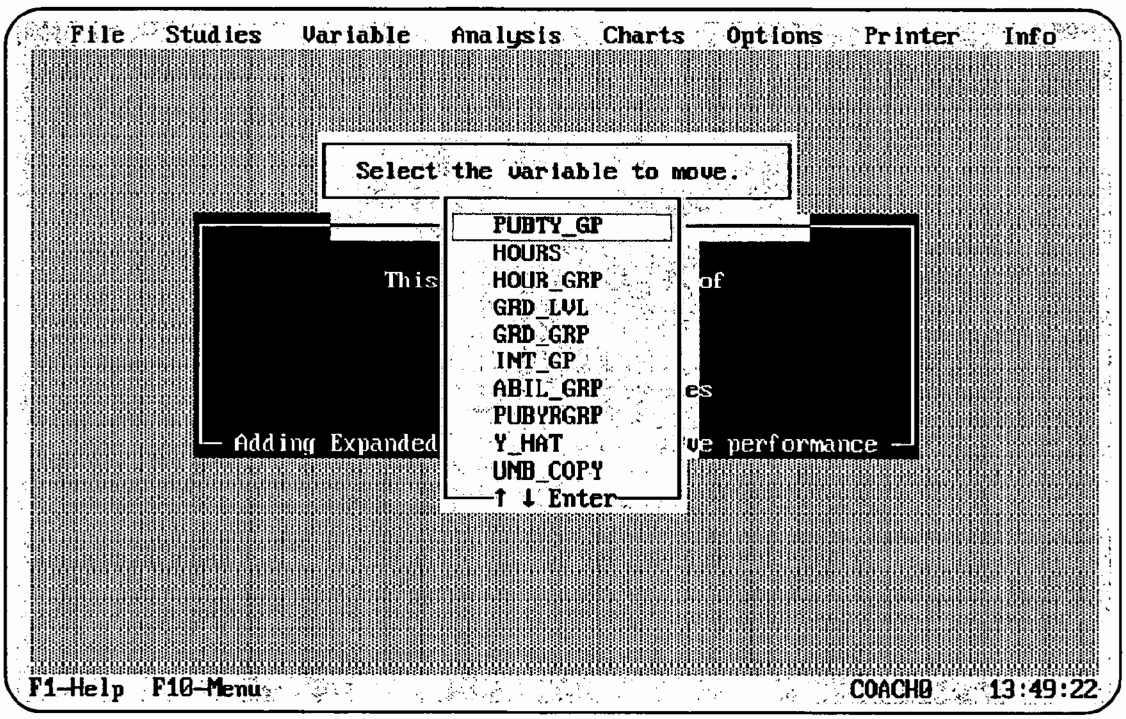
Moving a Variable

The order of variables determines the order in which you enter data for each study. If your data is set up in such a way that you want to enter one variable before another, you can change the order of the variables.

Follow these steps to move a variable:

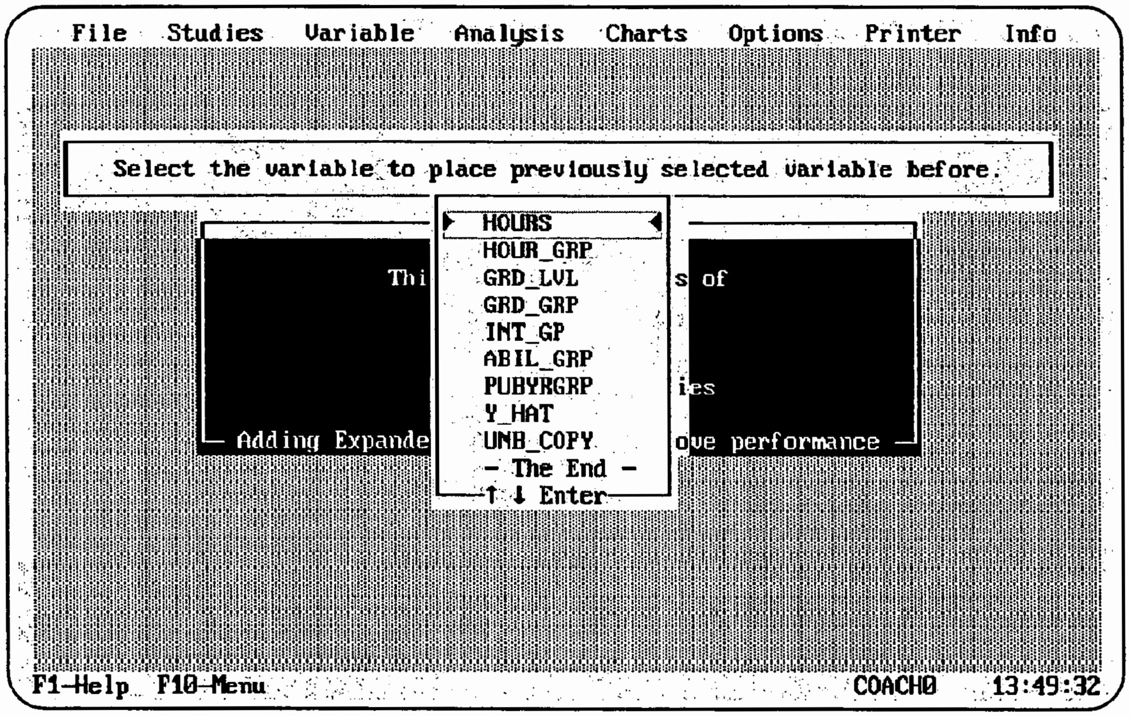
1. Select **Variable/Move**

   Meta-Stat displays a list of your variables:



2. Move the cursor to the variable you want to move, then press **Enter.**

   Meta-Stat prompts you to identify the location of the variable you are moving:



3. Move the cursor to the location where you want to move the variable.
4. Press **Enter** when you have finished.

   Meta-Stat rearranges your variables and study data.

Deleting a Variable

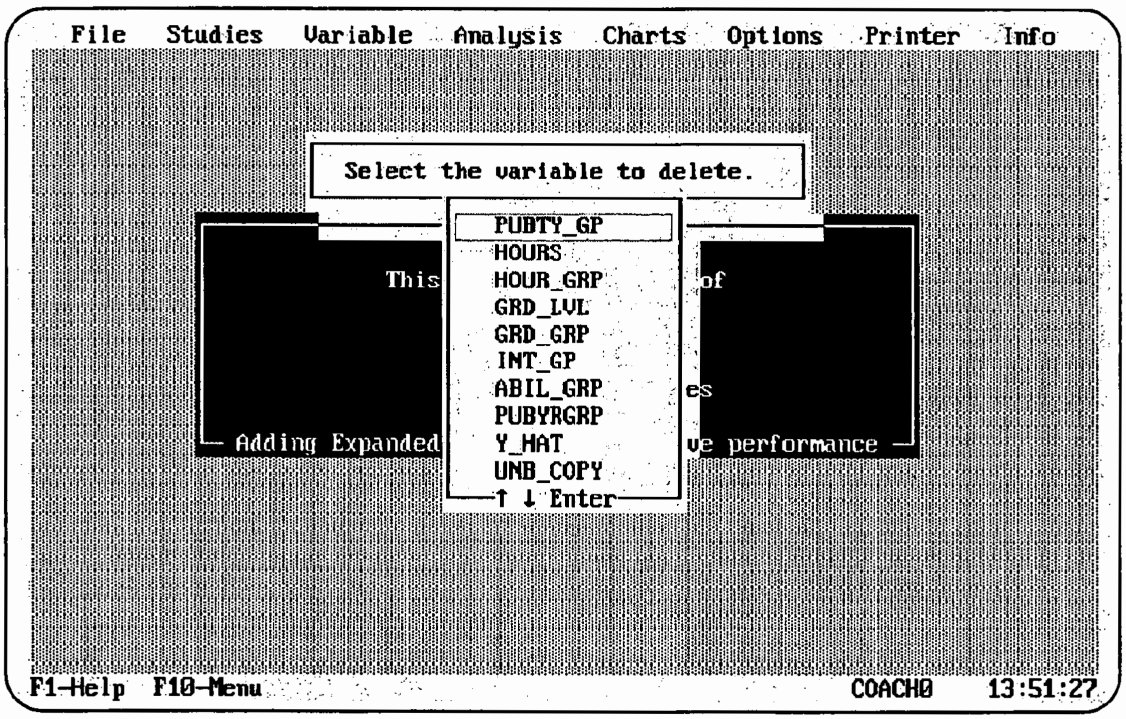
You can delete a variable that you no longer need. (However, you cannot delete a variable if other variables refer to it in equations.)

Warning: *Meta-Stat* will remove the variable and all study data that you have entered for the variable.

Follow these steps to delete a variable:

1. Select **Variable/Delete**

   Meta-Stat displays a list of your variables:



2. Move the cursor to the variable you want to delete, then press **Enter.**

   Meta-Stat prompts you to confirm the deletion. Press **Y** or **N.**

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Working with Libraries

Libraries are collections of pre-coded variables. ***Meta-Stat*** uses pre-coded variables, for example, when first defining an effect-size or correlation meta-file. You can create and use your own libraries of variables. You may, for example, want to import variables from a previous meta-analysis, or you may want to share variables and equations will colleagues.

- To create a library

  1. Select the variable you want to include in your library

     Select **Save to Lib.** ***Meta-Stat*** will then present a list of your current variables. Push **Enter** to select variables. A check will appear next to the selected variable. You may select one or all of the current variables to include in your library. If you push **Enter** again, the variable will be de-selected and the check mark will no longer appear.

     F9 to select all the variables on the list.

     Space to deselect all the variables on the list.

     F10 when you are done.

  2. Specify the library in which you want to save the variables.

     You can either add the variables to an existing library by selecting an existing library, or you can create a new library by pushing **Alt-C** and entering a new file name. Libraries should be saved with an .MLB extension.

- To edit an existing library

  1. Select **delete Library Variable**.
  2. Select a Library.
  3. Select the variable you want to delete by moving the cursor to the variable and pushing **Enter**.

- To use variables from an existing library.

  1. Select **Load from Lib**.
  2. Select the desired library name.
  3. Select the variables you want to add to your current meta-file. The selection follows the same conventions as **Save to Lib** discussed above.

6 Entering Study Data

This chapter describes how to create studies, enter study data, and display and print the data in various ways.

Creating a New Study

You must create a study before you can enter data for it into ***Meta-Stat***. Follow these steps:

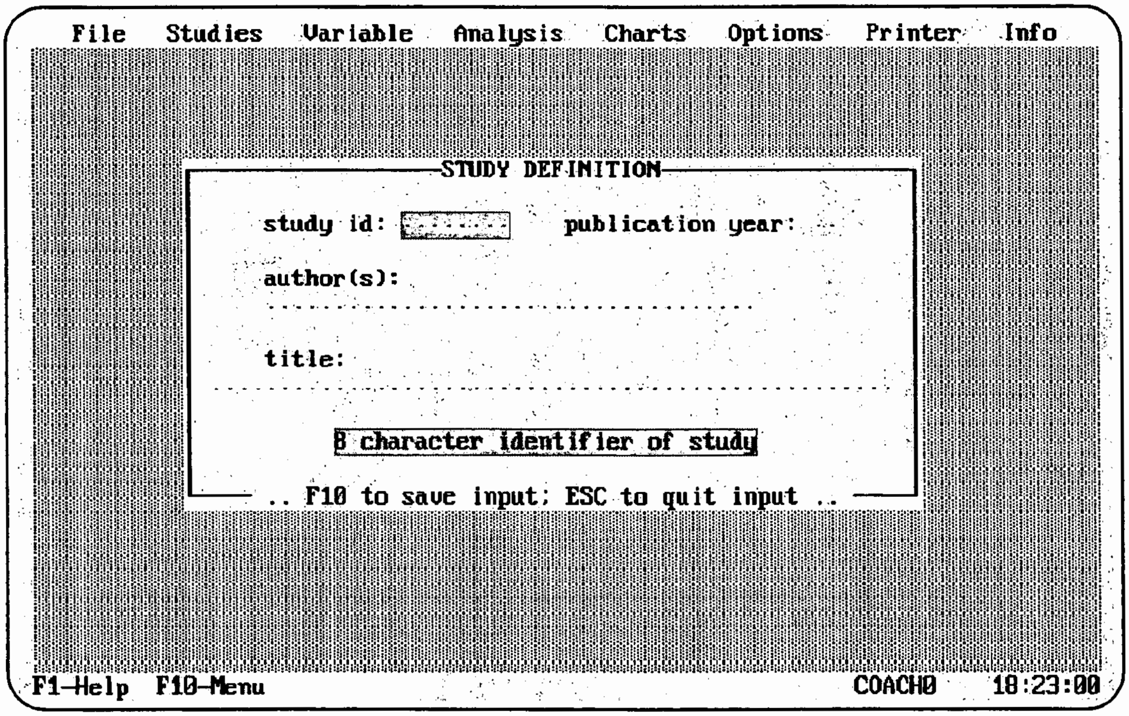
1. If necessary, open the meta-file to which you want to add the study:

    - Use **File/New** to create a new meta-file, or
    - Use **File/Open** to open an existing meta-file

    See Chapter 4 for more information about creating and opening meta-files.

2. Select **Studies/New**.

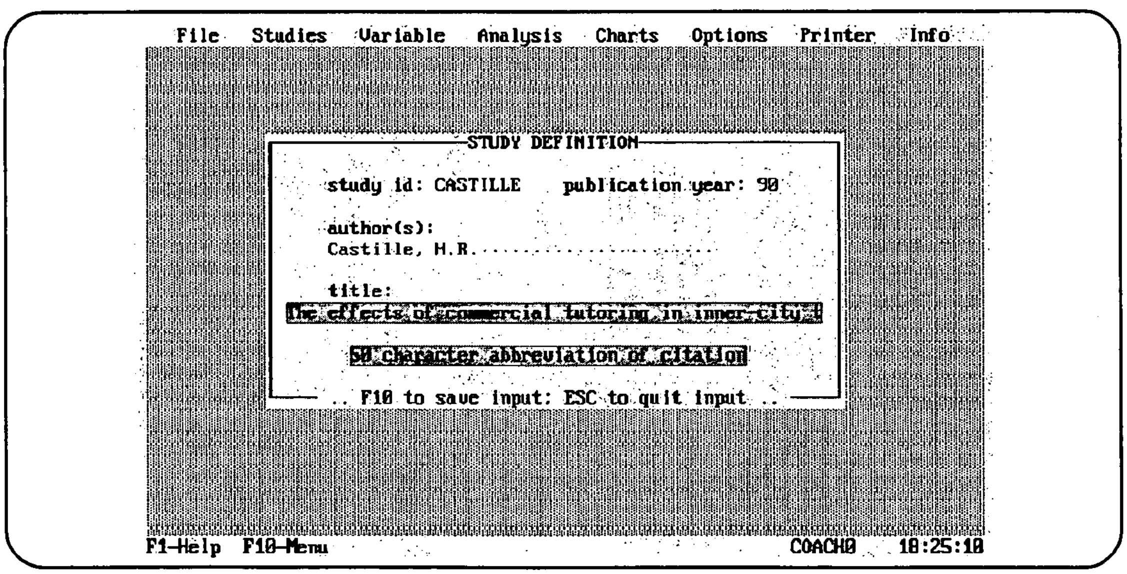
   Meta-Stat displays this screen:



3. Fill out the following information for the study. Press **Tab** or **Enter** to move from one field to the next.

Field	Enter this ...	Notes
study id	An identifier of the study. **Limit:** 8 characters	***Meta-Stat*** uses the **ID** to identify the study on screens and reports. Therefore, use a descriptive name, such as the first 8 characters of the author's name. The **ID** cannot start with a number or punctuation code.
publication year	Two digits to identify the year in which the study was published.	—
author(s)	The authors of the study. Limit: 8 characters	Enter the last names first to make your screens and reports more readable.
title	The study title. **Limit:** 50 characters	—

The following example shows a completed screen:



4. Press **F10** to save the new study.

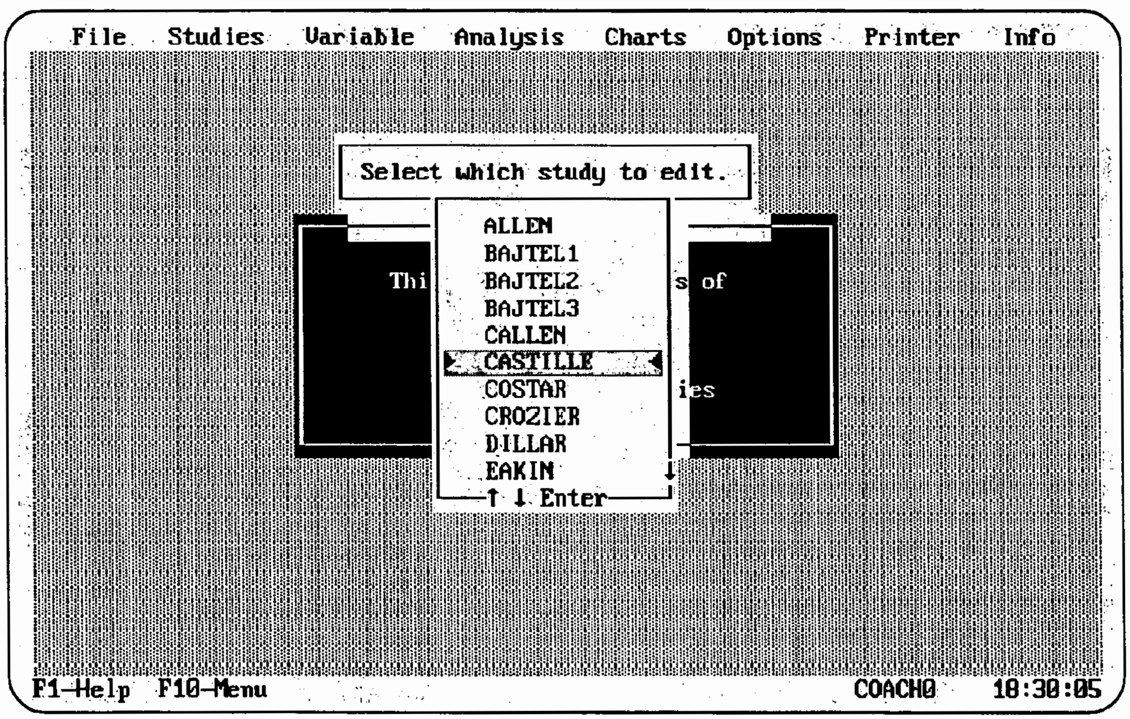
Entering Data for a Single Study

After you create a study, you can enter study data for each of the variables in your meta-analysis. This section shows you how to enter data for a single study. You can also enter data for multiple studies, as described in the section "Entering Data for a Group of Variables" later in this chapter.

To enter data, follow these steps:

1. Select **Studies/Edit**.

   Meta-Stat displays this screen:



2. Highlight the study you want to edit, then press **Enter**.

   Meta-Stat displays an editing screen. The study identifiers are shown at the top of the screen, followed by the variables and study data:

```
 File   Studies   Variable   Analysis   Charts   Options   Printer   Info
STUDY ID: CASTILLE  TITLE: The effects of commercial tutoring on inner city t
STUDY NUM: 6 of 31        AUTHORS: Castille, H.R.
 1 EFFECTSZ Effect Size
 2 UNBIASED Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ
 3 EFFSR_GP Effect size source ; 1=Correlation; 2=T-Statistic;
            3=F-Statistic; 4=Chi-Square; 5=Probability Level;
            6=Standardized Difference; 7=Direct Entry; 8=Gain
            Scores (parametric)                                        8
 4 EFF_CLTR Effect size cluster
 5 PUB_YR   Publication Year                                          90
 6 EXP_N    Experimental Group Size
 7 CTRL_N   Control Group Size
 8 TOTAL_N  Total Sample Size
            EXP_N + CTRL_N
 9 WEIGHT   Inverse of the variance
            (2*TOTAL_N*EXP_N*CTRL_N) / ((2*SQR(TOTAL_N)) + (EXP_N*
            CTRL_N*SQR(UNBIASED)))
10 PUBTY_GP Publication Type ; 1=journal; 2=dissert; 3=paper;
            4=book; 5=other
11 HOURS    Num of hrs of coaching

F1-Help F7-Back F8-Next F10-Menu           VAR 1 of 19    COACH0    18:30:48
```

General Editing Tips

To enter or edit data in a study, you can type directly at the cursor's location. In addition, you can use the following keys:

Press this key	To do this
Enter or **cursor-down**	Move the cursor to the next field for editing.
Back-Tab or **cursor-up**	Move the cursor to the previous field for editing.
PgDn	Display the next group of variables
F10	Save the study data and return to the **Studies** menu.
F7	Save the study data and display the previous study.
F8	Save the study data and display the next study.

F10 is the important key to remember. Press this key to save the data you have entered.

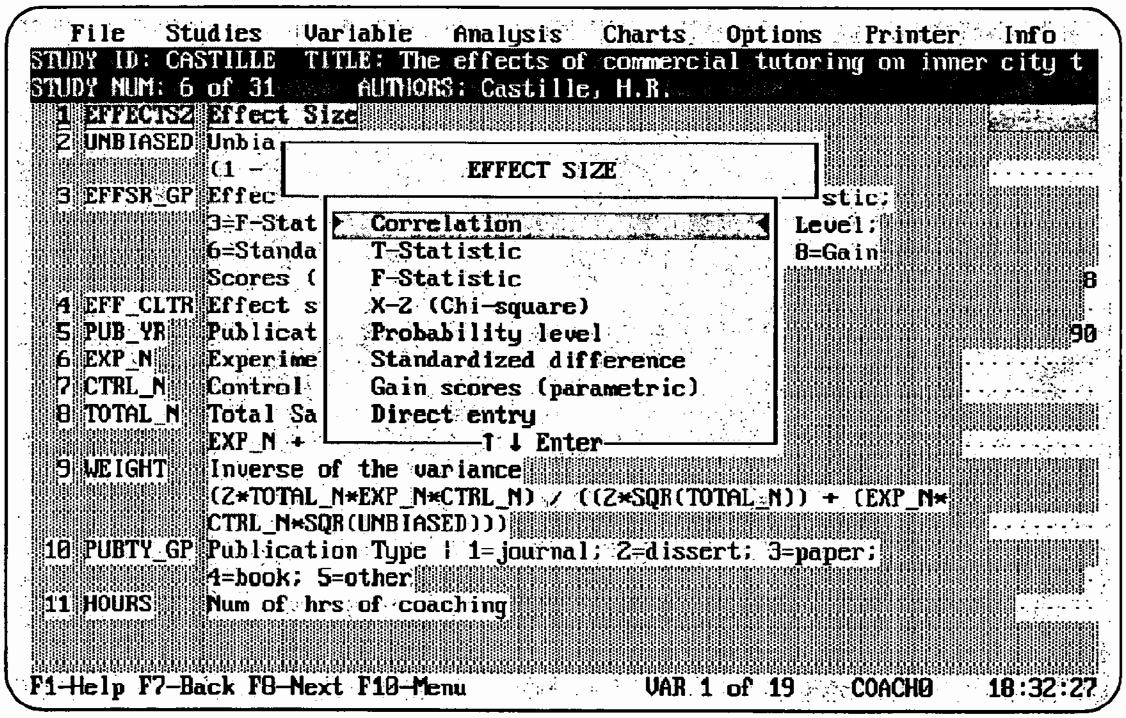
Entering the Effect Size

The first variable in effect-size meta-analysis is **EFFECTSZ**, the effect-size for a study. You can enter the **Effect Size** directly, by typing it directly into the **EFFECTSZ** field, or you can use an **Effect Size** calculator built into ***Meta-Stat***.

Follow these steps to enter the **Effect Size** using the effect size calculator.

1. With the cursor in the **EFFECTSZ** field, press **Tab**.

   Meta-Stat displays a screen on which you can select the source of the **Effect Size**:



2. Use the cursor keys to highlight the effect-size source for this study, then press **Enter**.

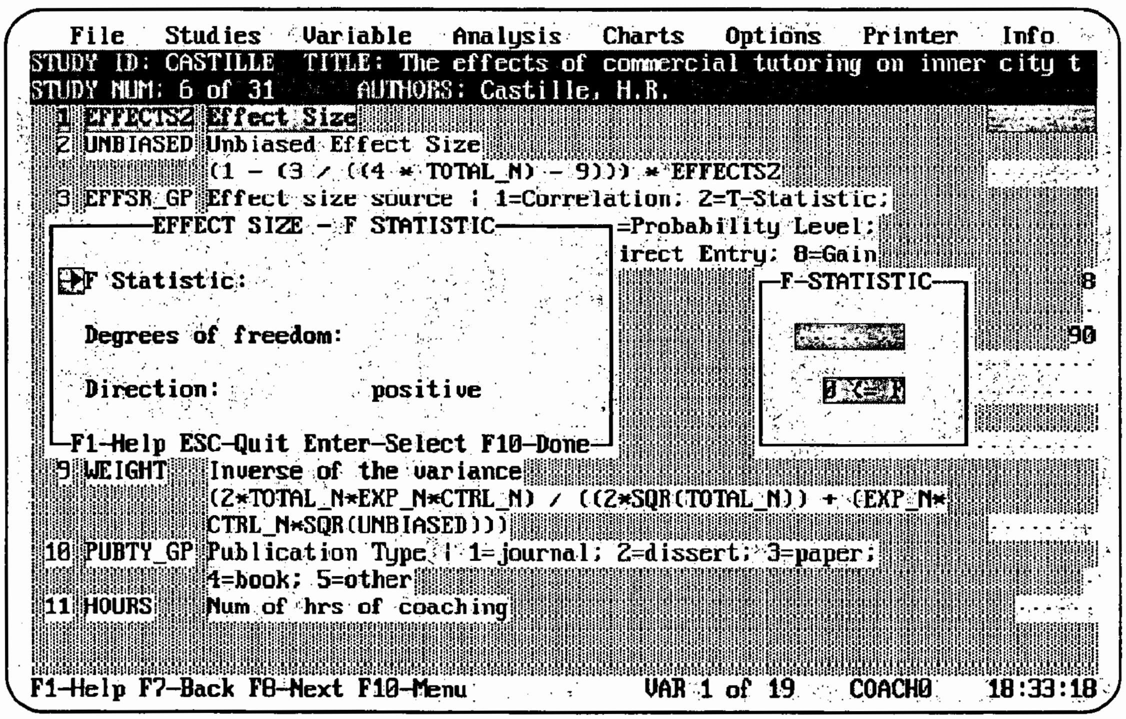
   Meta-Stat displays a screen where you can enter information about the source of the **Effect Size**. For example, if you want to calculate the **Effect Size** from the *F* Statistic reported in the study, ***Meta-Stat*** displays this screen:

```
  File   Studies   Variable   Analysis   Charts   Options   Printer   Info
STUDY ID: CASTILLE  TITLE: The effects of commercial tutoring on inner city t
STUDY NUM: 6 of 31        AUTHORS: Castille, H.R.
 1 EFFECTSZ Effect Size
 2 UNBIASED Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ
 3 EFFSR_GP Effect size source ; 1=Correlation; 2=T-Statistic;
┌─────────EFFECT SIZE - F STATISTIC──────────┐=Probability Level;
│                                            │irect Entry; 8=Gain
│►F Statistic:                               │                      8
│                                            │
│ Degrees of freedom:                        │                     90
│                                            │
│ Direction:            positive             │
│                                            │
└F1-Help ESC-Quit Enter-Select F10-Done──────┘
 9 WEIGHT   Inverse of the variance
            (2*TOTAL_N*EXP_N*CTRL_N) / ((2*SQR(TOTAL_N)) + (EXP_N*
            CTRL_N*SQR(UNBIASED)))
10 PUBTY_GP Publication Type ; 1=journal; 2=dissert; 3=paper;
            4=book; 5=other
11 HOURS    Num of hrs of coaching

F1-Help F7-Back F8-Next F10-Menu          VAR 1 of 19    COACH0    18:32:46
```

3. For each element of the source statistic, press **Enter** to display a window where you can enter needed information.

   For example, with the cursor next to **F Statistic**, press **Enter** to display a window where you can enter the *F* Statistic:



4. Use the same process to enter additional information. For example, referring to the *F* Statistic example shown above:

   - Press **cursor-down** to highlight **Degrees of freedom** for the denominator. (The degrees of freedom for the numerator is set to 1 as the conversion formula is only applicable when the *F* Statistic is calculated for two groups.)
   - Press **Enter**
   - Enter the denominator degrees of freedom in the window that ***Meta-Stat*** displays

- Press **Enter** to close the window
- **Direction** refers to whether the mean differences show a positive result (i.e., treatment group is greater that the control group) or vice versa.

Working with Equations and Blocking Variables

You cannot directly enter data for variables that have been defined as equations or blocking variables. ***Meta-Stat*** calculates the values of these variables for you.

However, you can enter data for an equation if a component of the equation is missing. For example, if a study did not use control subjects, you can skip the **CTRL_N** (control group size) variable. ***Meta-Stat*** then allows you to directly enter **TOTAL_N** (total sample size), because one of the components of the **TOTAL_N** equation is missing.

Viewing Another Study During Data Entry

While editing one study, it is often helpful to be able to view the contents of another study.

1. Select **Studies/View Another**
2. In the list that ***Meta-Stat*** displays, select the study you want to view by highlighting it and pressing **Enter**.

Meta-Stat displays the second study below the first:

```
  File   Studies   Variable   Analysis   Charts   Options   Printer   Info
STUDY ID: CASTILLE   TITLE: The effects of commercial tutoring on inner city t
STUDY NUM: 6 of 31       AUTHORS: Castille, H.R.
 1 EFFECTSZ Effect Size                                                  0.790
 2 UNBIASED Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ                ........
 3 EFFSR_GP Effect size source | 1=Correlation; 2=T-Statistic;
            3=F-Statistic; 4=Chi-Square; 5=Probability Level;
            6=Standardized Difference; 7=Direct Entry; 8=Gain
            Scores (parametric)                                              3
──────────────────────────────────VIEW STUDY──────────────────────────────────
STUDY ID: COSTAR     TITLE: Scoring high in reading:  The effectiveness of tea
STUDY NUM: 7 of 31       AUTHORS: Costar, E.
 1 EFFECTSZ Effect Size                                                 12.000
 2 UNBIASED Unbiased Effect Size
            (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ                  11.586
 3 EFFSR_GP Effect size source | 1=Correlation; 2=T-Statistic;
            3=F-Statistic; 4=Chi-Square; 5=Probability Level;
            6=Standardized Difference; 7=Direct Entry; 8=Gain
            Scores (parametric)                                              7
 4 EFF_CLTR Effect size cluster                                              0
 5 PUB_YR   Publication Year                                                81
 6 EXP_N    Experimental Group Size                                         12
─────────────── ↑  ↓  PgUp  PgDn  Home  End  F7  F8  F10  <Esc> ──────────────
F1-Help F7-Back F8-Next F10-Menu            VAR 1 of 19    COACH0    18:34:41
```

Entering Data for a Group of Variables

As an alternative to entering data for all variables for a single study, you can enter data for a group of variables. You select the variables you want to work with, and *Meta-Stat* displays only those variables for each study. This allows for fast entry.

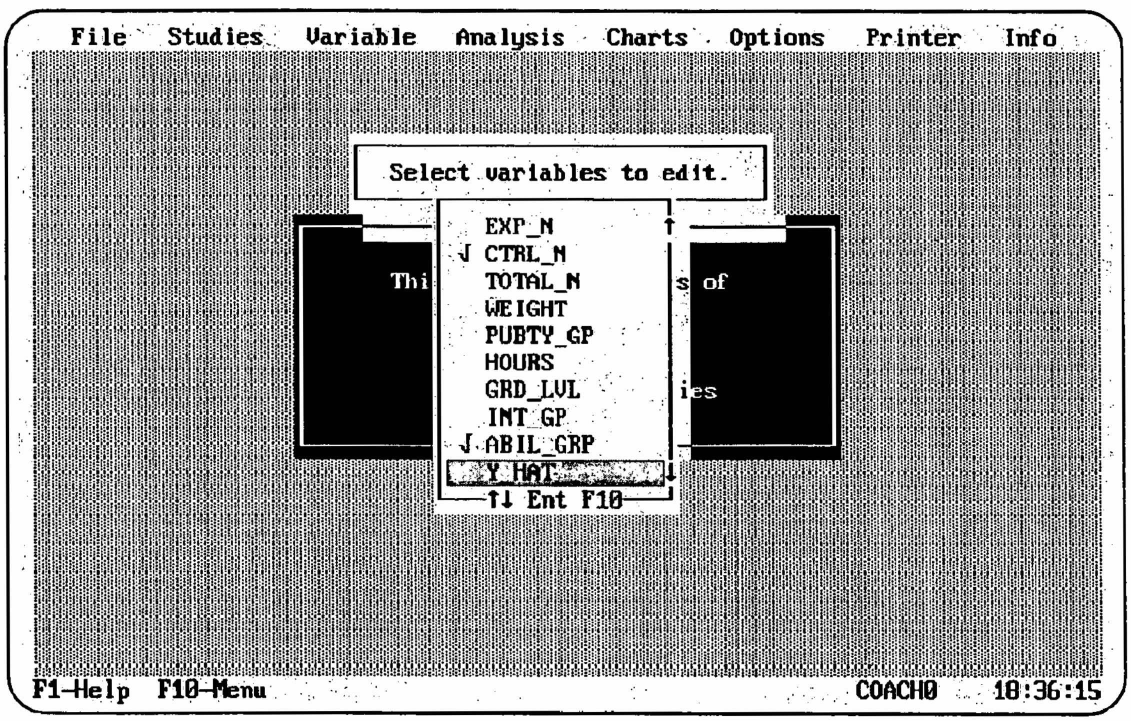
Follow these steps:

1. Select **Studies/Edit Grp of Vars**

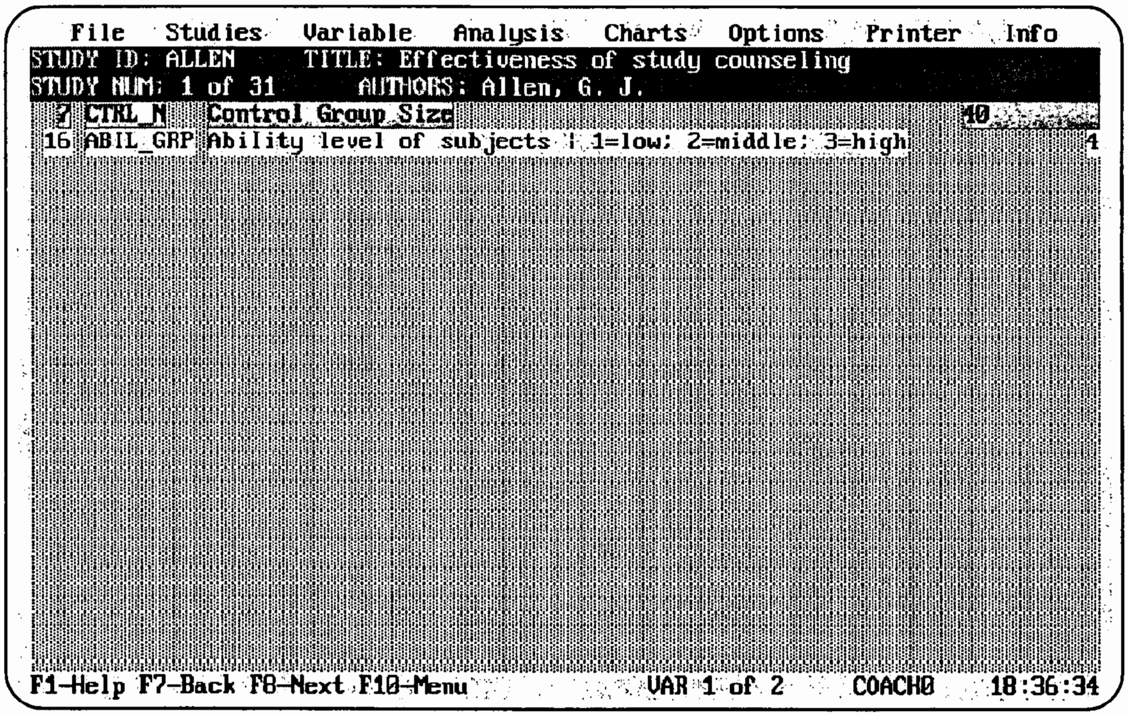
   Meta-Stat displays a list of variables.

2. Use the cursor keys to highlight each variable you want to work with, then press **Enter**.

   In the following example, two variables have been selected:



3. Press **F10** when you have finished selecting variables. ***Meta-Stat*** displays the variables for the first study in your meta-file:



4. Use the normal editing features of ***Meta-Stat*** to enter or edit data for the variables.

5. Press **F8** and **F7** to display the next and previous studies, respectively.

Keeping Studies Sorted

When you create a new study, ***Meta-Stat*** adds it as the last study in your meta-analysis. When you display a list of studies, or want to select a study to edit, ***Meta-Stat*** displays the studies in the order in which you created them.

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To make it easier to find studies in your meta-analysis, you should periodically sort your studies. You can sort studies by:

- Study **ID**

  If you used the author's last name as the variable **ID**, this sort order provides you with an alphabetical list of your studies.

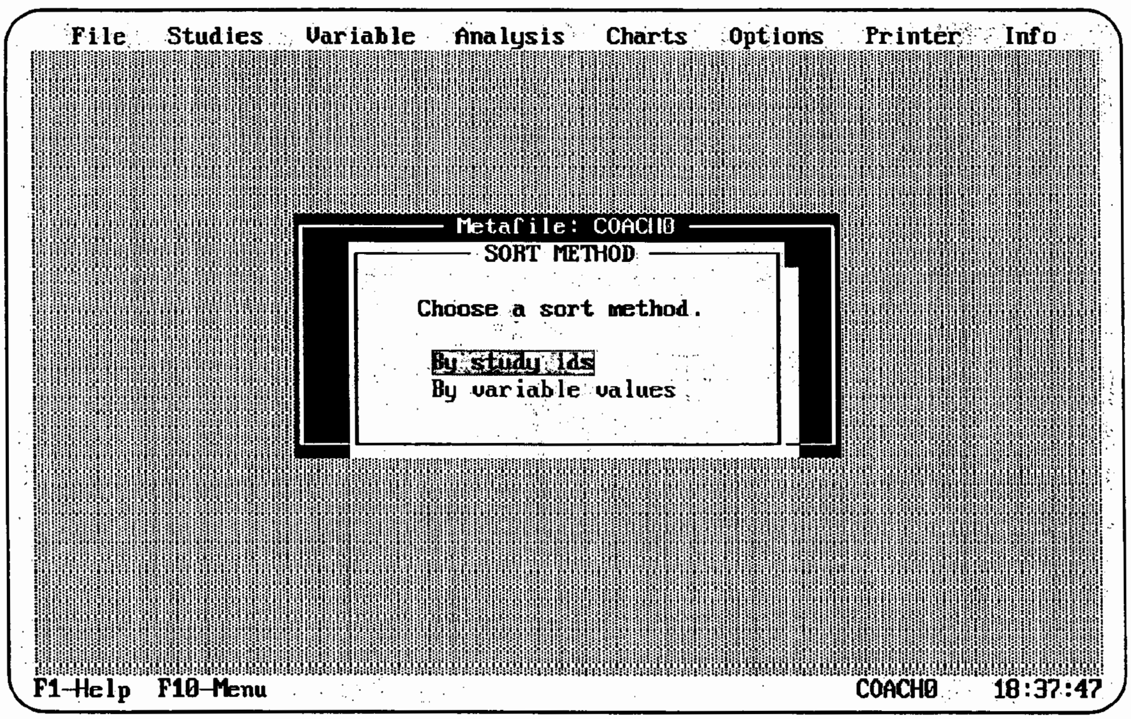
- Variable values

  For example, if you want to sort your studies chronologically, you could sort them according to the **PUB_YR** variable. You can sort in ascending or descending order.

To change the sort order, or to keep studies sorted after you add new studies, follow these steps:

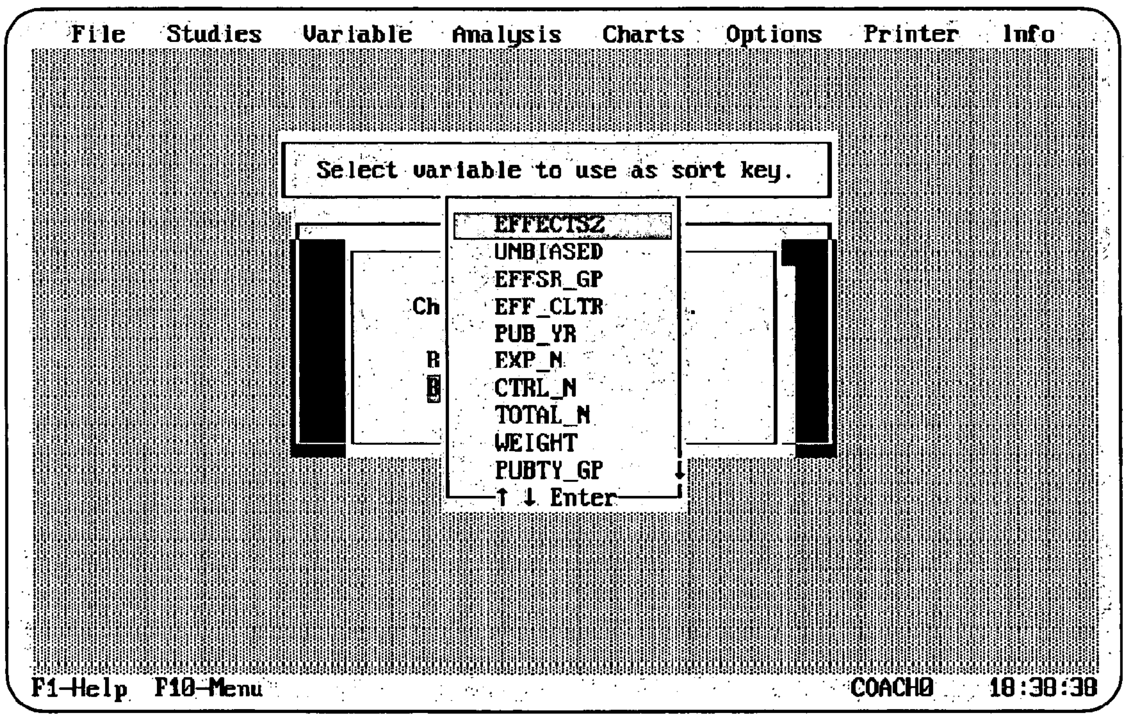
1. Select **Studies/Sort**

   Meta-Stat asks you to select the type of sort you want to perform:



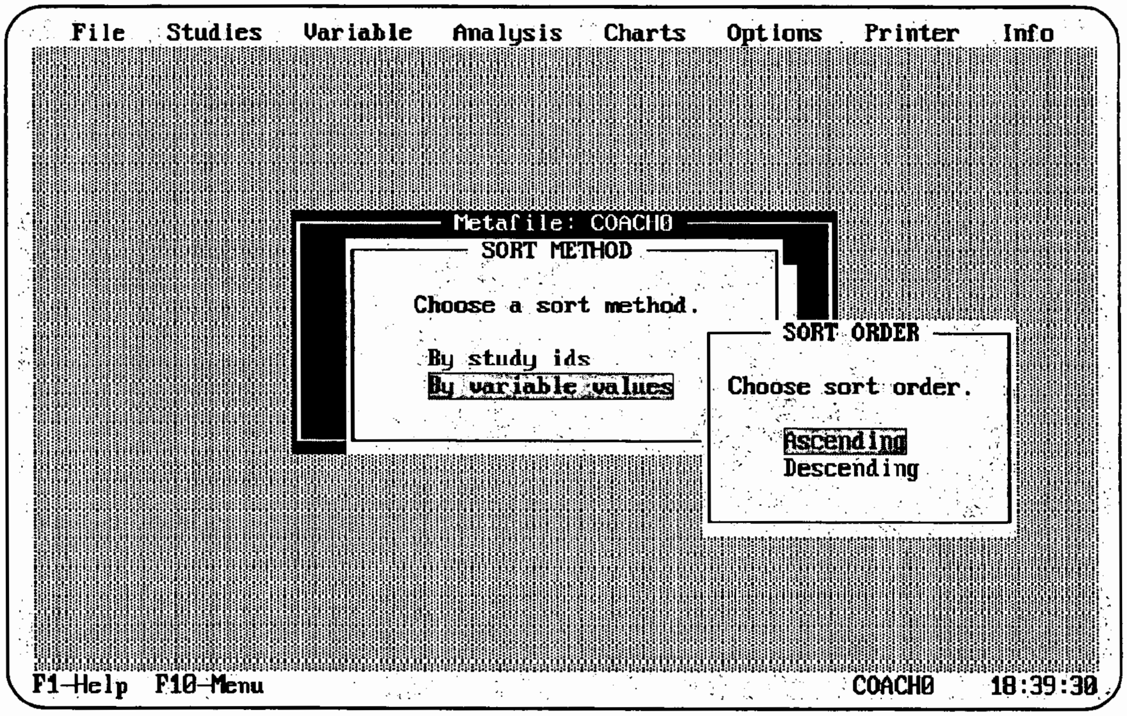
2. Highlight the type of sort you want to perform, then press **Enter**.

   If you are sorting by study **IDs**, ***Meta-Stat*** sorts your studies. If you are sorting by variable values, ***Meta-Stat*** asks you to select the variable to use:



3. Highlight the variable you want to use to sort the studies, then press **Enter**.

   Meta-Stat asks you to select a sort sequence:



4. Highlight **Ascending** or **Descending**, then press **Enter**.

   Meta-Stat sorts your studies in the order you selected.

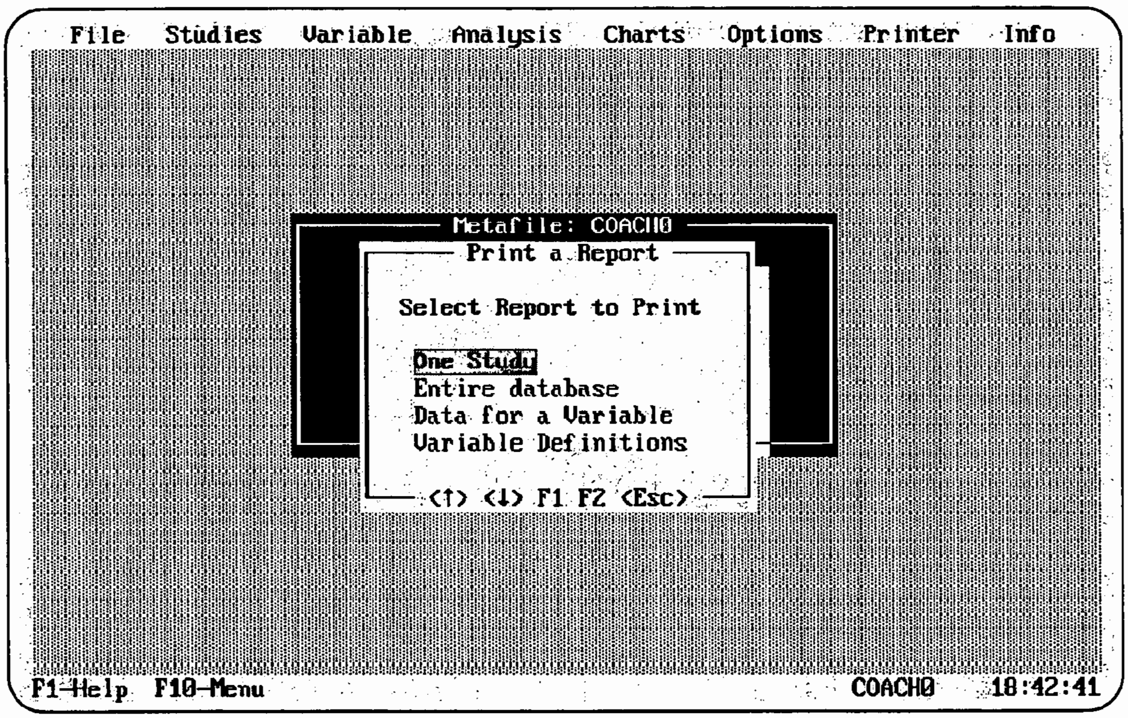
Displaying and Printing Study Data

Meta-Stat provides a variety of ways to display and print data from your studies. (To find out about printing statistics and graphs, see the Chapters 6 and 7.)

Displaying a List of Studies

From within *Meta-Stat*, you can quickly display a list of studies.

Use **Studies/view Reference** to display the list:



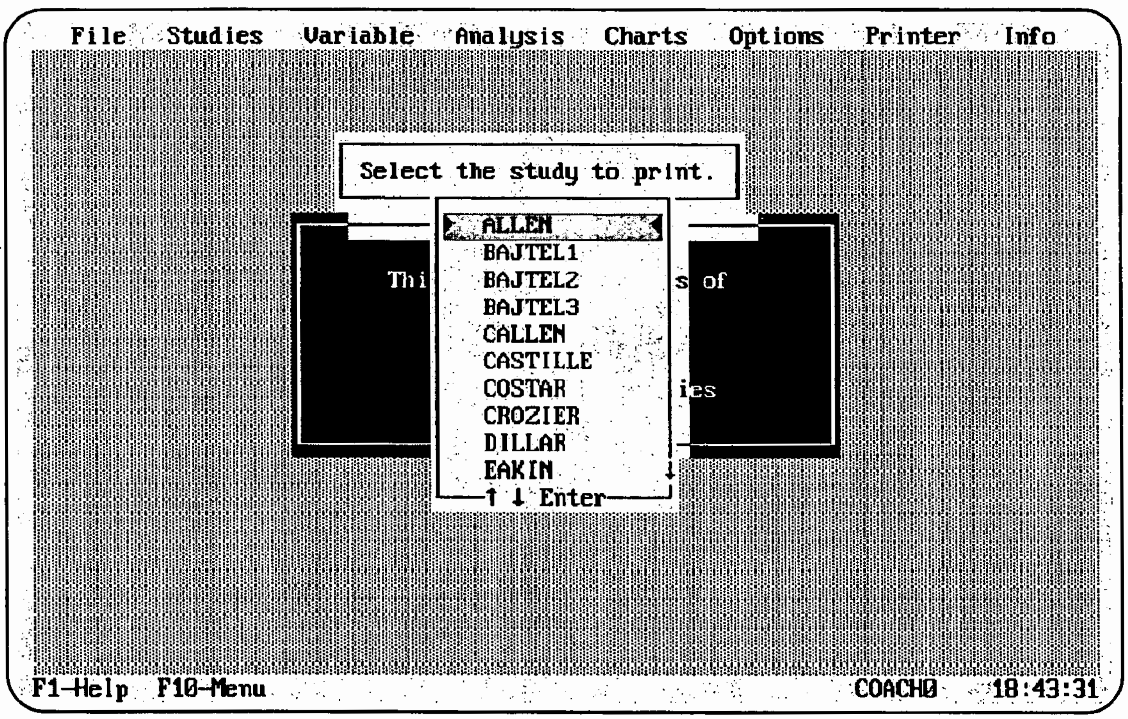
Printing Studies

You can print all information you have entered for a single study. Follow these steps:

1. Use **Printer/Destination**, if necessary, to select where you want to send the printed information. *See Chapter 2 for more information about this menu option.*

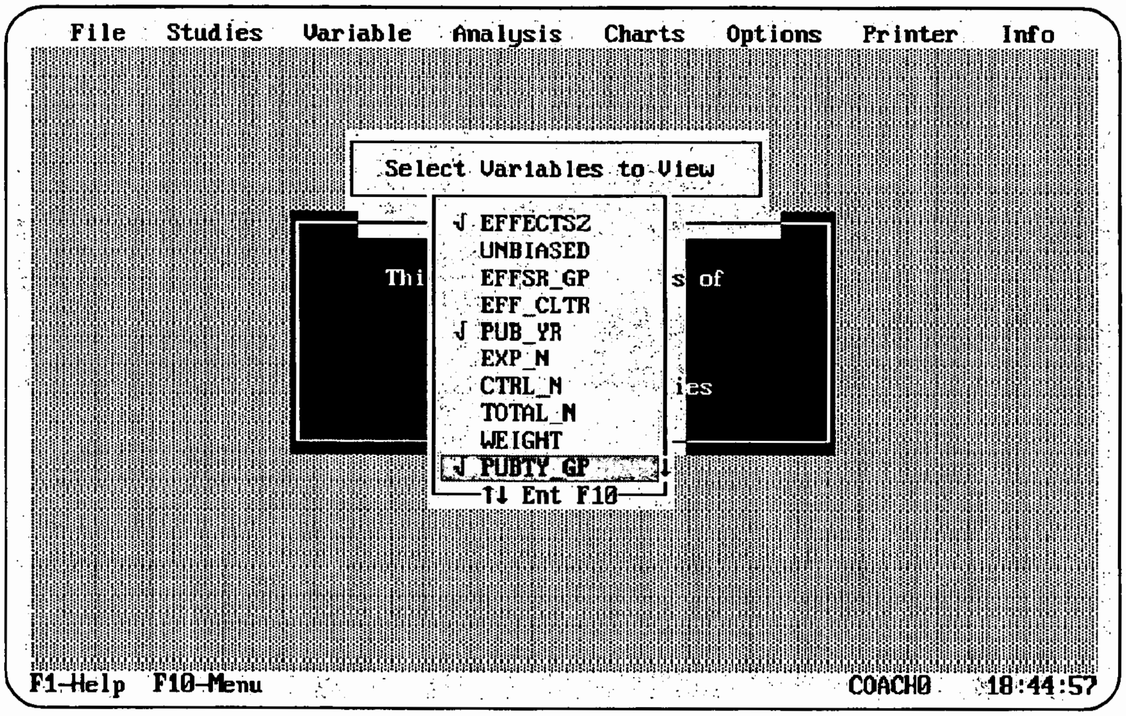
2. Select **File/Print Reports.**

   Meta-Stat prompts you to select what you want to print:



3. Select **One Study** to print a single study. Select **Entire Database** to print all studies in the meta-analysis.

If you selected **One Study**, *Meta-Stat* prompts you to select the study you want to print:



4. If you are printing a single study, highlight the study you want to print and press **Enter**.

Meta-Stat prints the studies you selected:

```
META                                                        PRINTED:  06/02/93
LMP Associates, Inc.                                                  12:36:06

Meta-file NAME:                                                       PAGE:  1
-----------------------------------------------------------------------------
STUDY ID: ALLEN    TITLE: Effectiveness of study counseling
STUDY NUM: 1       AUTHOR(S): Allen, G. J.

 VAR VAR      VARIABLE                                              DATA
  #  ID       DESCRIPTOR                                            VALUE
 --- -------- --------------------------------------------------- ----------
   1 EFFECTSZ Effect Size                                              0.918
   2 UNBIASED Unbiased Effect Size
              (1 - (3 / ((4 * TOTAL_N) - 9))) * EFFECTSZ               0.909
   3 EFFSR_GP Effect size source | 1=Correlation; 2=T-Statistic;
              3=F-Statistic; 4=Chi-Square; 5=Probability Level;
              6=Standardized Difference; 7=Direct Entry; 8=Gain
              Scores (parametric)                                          2
   4 EFF_CLTR Effect size cluster                                          0
   5 PUB_YR   Publication Year                                            67
   6 EXP_N    Experimental Group Size                                     41
   7 CTRL_N   Control Group Size                                          40
   8 TOTAL_N  Total Sample Size
              EXP_N + CTRL_N                                              81
   9 WEIGHT   Inverse of the variance
              (2*TOTAL_N*EXP_N*CTRL_N) / ((2*SQR(TOTAL_N)) + (EXP_N*
              CTRL_N*SQR(UNBIASED)))                                  18.351
  10 PUBTY_GP Publication Type | 1=journal; 2=dissert; 3=paper;
              4=book; 5=other                                              2
  11 HOURS    Num of hrs of coaching                                  ......
  12 HOUR_GRP Duration of program
              1=short: (HOURS>0) and (HOURS < 1)
              2=average: (HOURS >= 1) and (HOURS <=1.5)
              3=long: HOURS > 1.5                                          .
  13 GRD_LVL  Grade Level 1 thru 18                                       14
  14 GRD_GRP  Grade Group
              1=Elementary: (GRD_LVL >= 1) and (GRD_LVL <= 6)
              2=High Sch: (GRD_LVL >= 7) and (GRD_LVL <= 12)
              3=College: (GRD_LVL >= 13) and (GRD_LVL <= 18)
```

Viewing Data for Selected Variables

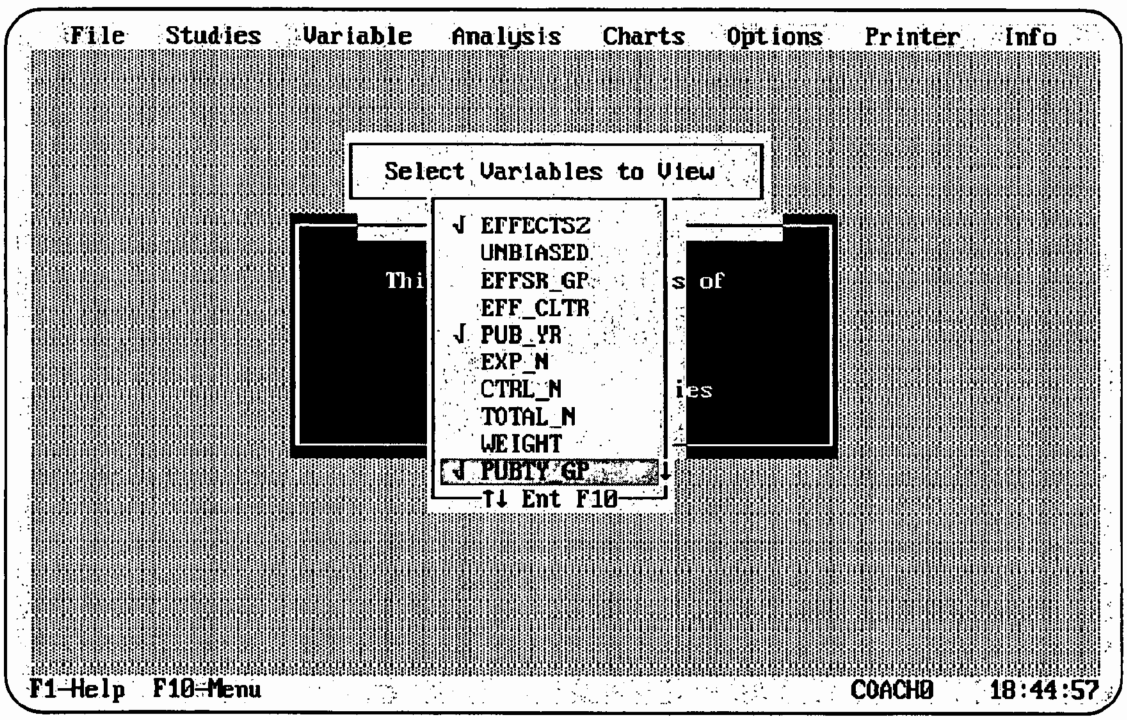
If you want to review quickly only some variables for your studies, you can select the variables you want to see rather than viewing study data for all variables. Follow these steps:

1. Select **Studies/View Variables.**

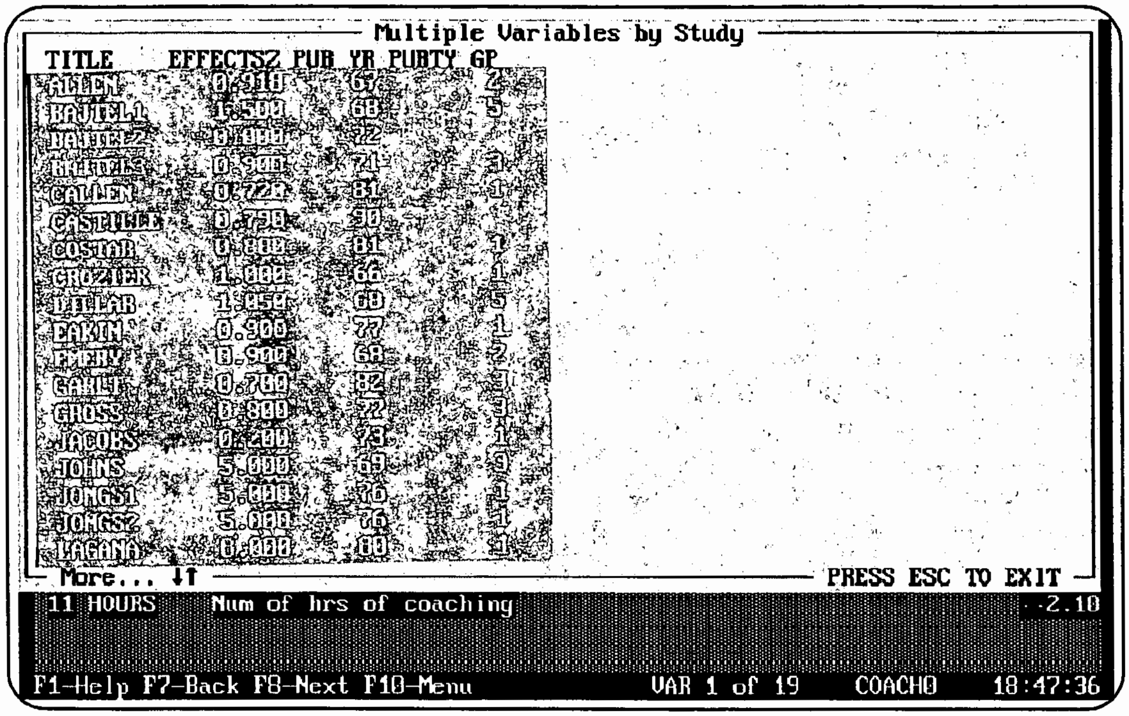
   Meta-Stat asks you to identify the variables you want to view.

2. Move the highlight to each variable you want to view and press **Enter**. If you select a variable by mistake, press **Enter** a second time to deselect it.

   In the following example, three variables have been selected:



3. Press **F10** to display the variables for each study:



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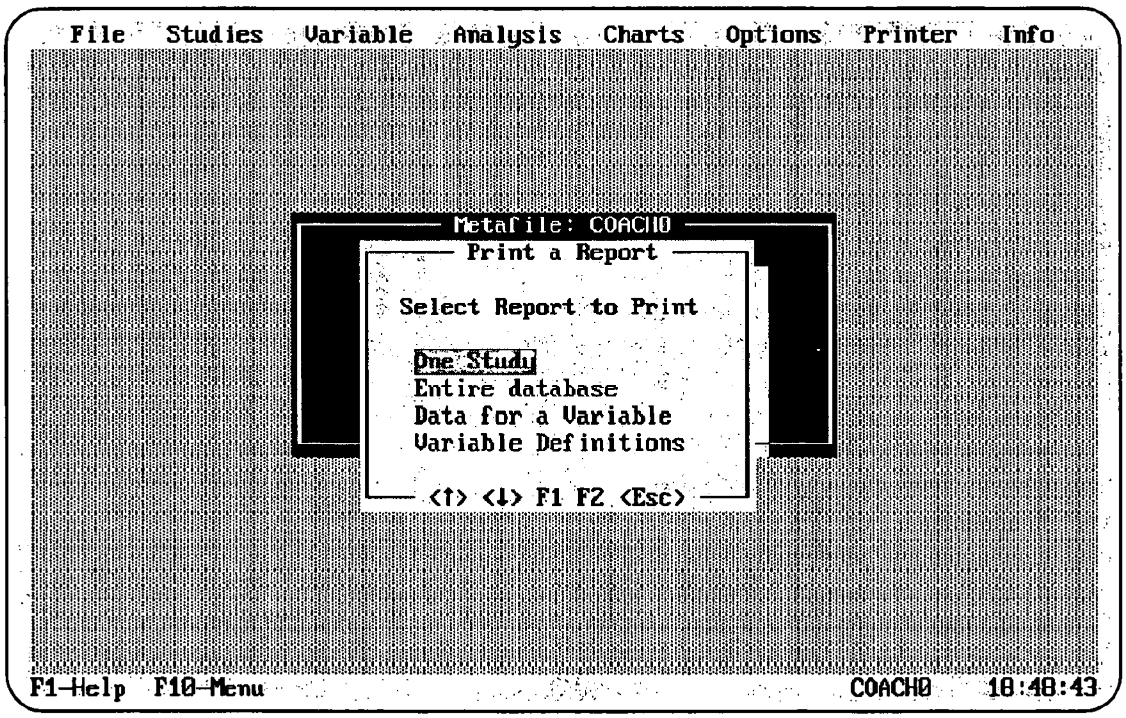
Printing Data for Selected Variables

You can print study data for only selected variables. Follow these steps:

1. Use **Printer/Destination**, if necessary, to select where you want to send the printed information. *See Chapter 2 for more information about this menu option.*

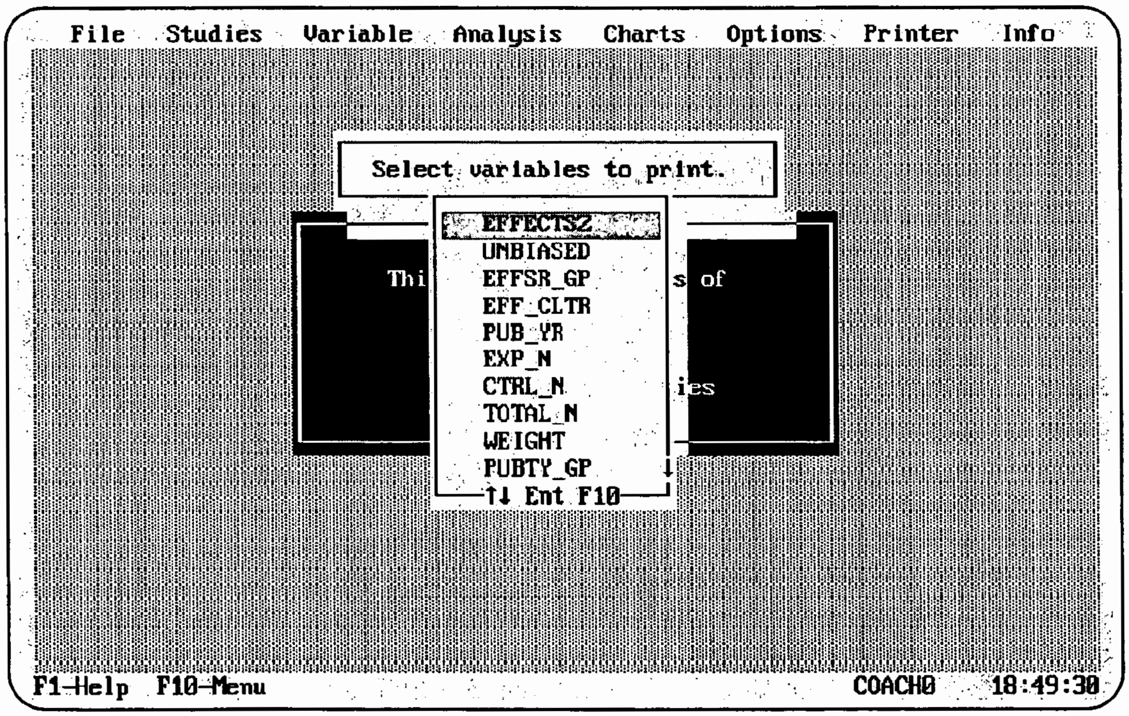
2. Select **File/Print Reports.**

   Meta-Stat prompts you to select what you want to print:



3. Select **Data for a Variable**.

   Meta-Stat prompts you to identify the variables you want to print:



4. Highlight each variable you want to print and press **Enter**.

   If you select a variable by mistake, press **Enter** a second time to deselect it.

5. Press **F10** to print the variables. In the following example, the **EFFECTSZ** variable has been printed:

```
META                                                              PRINTED:  06/02/93
LMP Associates, Inc.                                                        13:11:12


Meta-file NAME:  COACHO                                                     PAGE:  1
------------------------------------------------------------------------------------
VARIABLE: EFFECTSZ Effect Size                        Variable Type: Continuous

STUDY ID  TITLE                                AUTHOR                  EFFECTSZ
------  ---------------------------------  ---------------        ---------
ALLEN     Effectiveness of study counseling    Allen, G. J.               0.918
BAJTEL1   Test-wiseness and systematic desens  Bajtelsmit, J.             2.500
BAJTEL2   Test-wiseness and systematic desens  Bajtelsmit, J.             0.500
BAJTEL3   Test-wiseness and systematic desens  Bajtelsmit, J.             0.200
CALLEN    The effects of instruction and prac  Callenbach, C.             0.200

CASTILLE  The effects of commercial tutoring   Castille, H.R.             0.750
COSTAR    Scoring high in reading: The effec   Costar, E.                 0.200
CROZIER   An evaluation of the effectiveness   Crozier, P. W.             1.000
DILLAR    Efficacy of test-wiseness on test a  Dillard, Warrio            1.900
EAKIN     The effects of an instructional tes  Eakins, Green,             0.500

EMERY     Standard vs individual hierarchies   Emery, J. R. &             1.000
```

Copying a Study

You might want to copy a study to:

- Place a copy of the study on diskette for safekeeping
- Experiment with the study

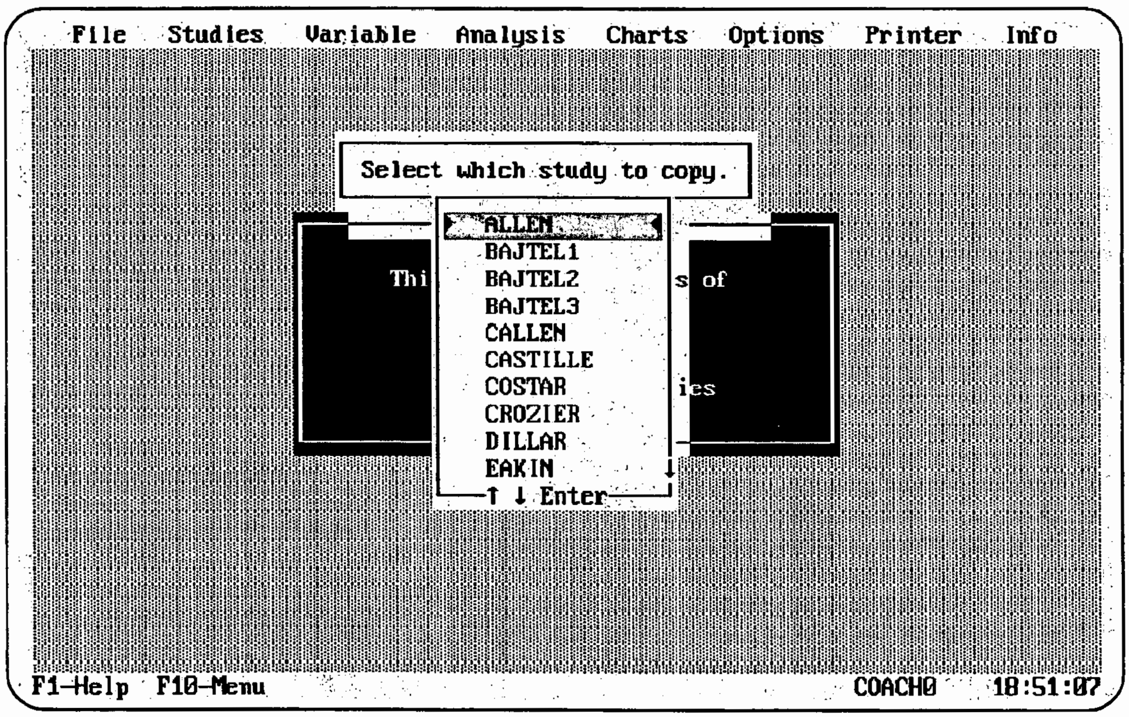
  (You can experiment with the copy rather than the original)
- Add a study to your meta-analysis that is similar to an existing study

  (You can copy the study and make changes to the copy)

To copy a study, follow these steps:

1. Select **Studies/Copy**

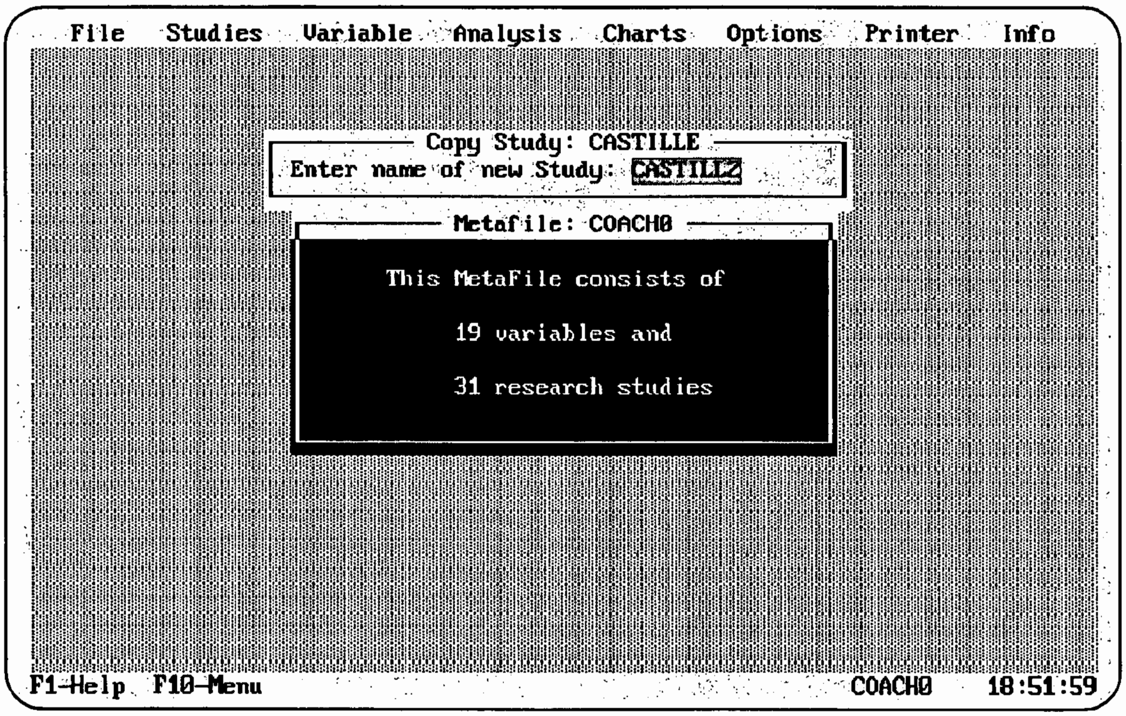
   Meta-Stat asks which study you want to copy:



2. Highlight the study you want to copy and press **Enter.**

   Meta-Stat asks for the new name of the study.

3. Use **Ins, Del**, and other editing keys to change the name of the copy. In the following example, a study named **CASTILLE** is being copied to a study named **CASTILL2**:



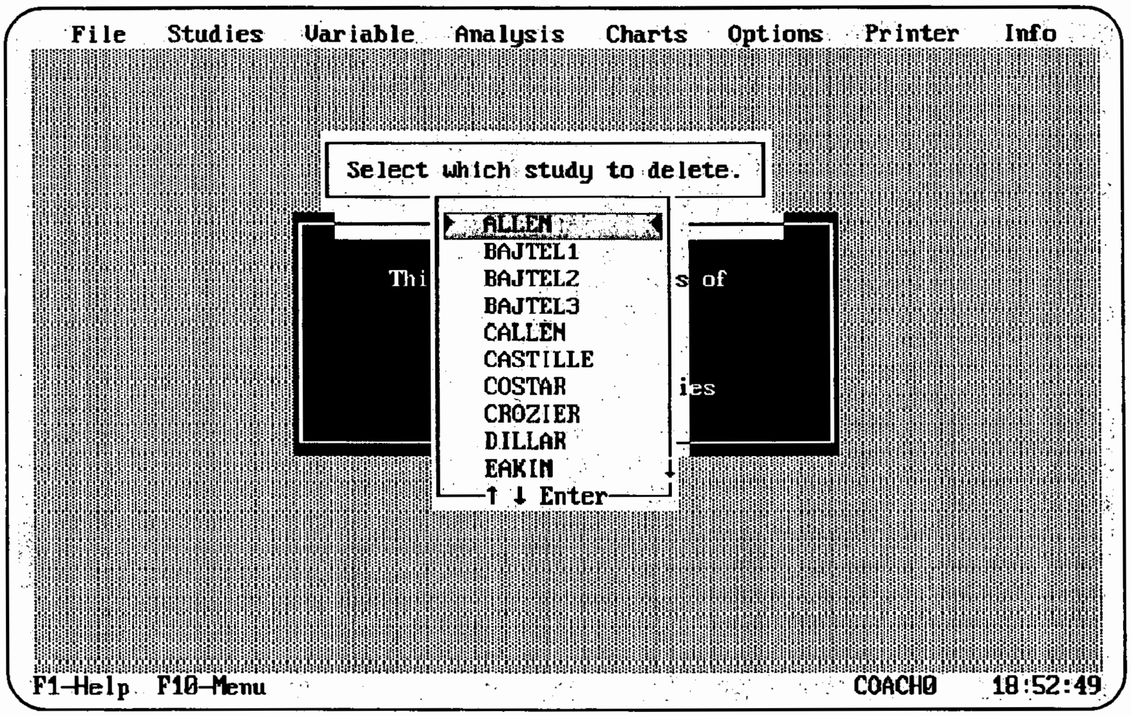
4. Press **Enter** to copy the study.

Deleting a Study

If you no longer need a study, you can delete it. Follow these steps:

1. Select **Studies/Delete**.

   Meta-Stat asks you to identify the study:



2. Highlight the study you want to delete and press **Enter**.

   Meta-Stat asks you to confirm.

3. Press **Y** to confirm the deletion or **N** to cancel.

7 Applying Statistical Techniques

Meta-Stat provides a wealth of statistical tools to help you examine your data.

Overview

The appropriate role for inferential statistics in meta-analysis is not merely unclear, it is seen quite differently by different methodologists.

In 1981, in the first extended discussion of the topic, Glass, McGaw and Smith raised doubts about the applicability of inferential statistics for the meta-analysis problem. Inference at the level of persons within studies (of the type address by Rosenthal 1984) seemed quite unnecessary to them, since even a modest size synthesis will involve a few hundred persons (nested within studies) and lead to nearly automatic rejection of null hypotheses. Moreover the chances are remote that these persons or subjects within studies were drawn from defined populations with anything approaching probabilistic techniques; hence, probabilistic calculations advanced as if subjects had been randomly selected are dubious.

At the level of "studies," the question of the appropriateness of inferential statistics can be asked again, and Glass et al. seem to answer in the negative. They pointed out that there are two instances in which common inferential methods are clearly appropriate: when a defined population has been randomly sampled and when subjects have been randomly assigned to conditions in a controlled experiment. In the latter case, Fisher showed how the permutation test can be used to make inferences to the universe of all possible permutations. But this case in of little interest to meta-analysts who never assign units to treatments. Glass et al. claimed that the typical meta-analysis virtually never meets the condition of probabilistic sampling of a population[1]. They took the position that inferential statistics has little role to play in meta-analysis: "The probability conclusions of inferential statistics depend on something like probabilistic sampling, or else they make no sense" (p. 199).

It is a common habit of thought to acknowledge that many data sets fail to meet probabilistic sampling conditions , but to argue that one might well treat the data in hand "as if" it were a random sample of some hypothetical population. Under this supposition, inferential techniques are applied and the results inspected. This circumlocution has neither logic nor common sense to support it. Indeed, it seems to be little short of a rationalization for performing statistics that one has gone to the trouble to learn whether they are appropriate or not. If the sample is fixed and the population is allowed to be hypothetical, then surely the data analyst will imagine a population that resembles the sample of data. Hence all of these "hypothetical populations" will be reflections of the samples and there will be no need for inferential statistics. The researcher runs the risk of generalizing to what well may be a fictitious, and hence irrelevant, population.

Hedges and Olkin (1985) developed inferential techniques that ignored the pro forma testing of null hypotheses and focused on the estimation of regression functions that estimate effects at different levels of study characteristics. They worried about both sources of statistical instability: that arising from persons within studies and that which arises from variation between studies. As they properly pointed out, the study based on 500 persons deserves greater weight than the study based on 5 persons in determining the response of the treatment condition to changes in study conditions. The techniques they present are based on traditional assumptions of random sampling and independence. It is, of course, unclear precisely how the validity of their methods are compromised by failure to achieve probabilistic sampling of persons and studies.

Rubin (1990) addressed most of these issues squarely and staked out a position that appeals to the authors of this manual: "...consider the idea that sampling and representativeness of the studies in a meta-analysis are important. I will claim that this is nonsense--we don't have to worry about representing a population but rather about other far more important things" (p. 155). These more important things to Rubin are the estimation of treatment effects under a set of standard or ideal study conditions. This process, as he outlined it, involves the fitting of

[1] In one instance known to Smith, Glass & Miller (1980), the available population of drug treatment experiments was so large that it was in fact randomly sampled for the meta-analysis.

response surfaces (a form of quantitative model building) between study effects (Y) and study conditions (X, W, Z etc.).

Where theorists disagree, technicians are well advised to leave open as many options as possible. Consequently, we have provided many methods of data analysis in ***Meta-Stat*** that address inferential issues, including Hedges's homogeneity tests, Rosenthal and Rubin's aggregate significance levels as well as conventional methods of analysis like regression, and a newly rediscovered approximate randomization test[2].

> ***Where conditions of random sampling are met, the inferential techniques in Meta-Stat will have clear and undisputed application. In all other instances, it will be up to the meta-analyst to decide whether to apply them and how to interpret them. We provide fair warning that the inferential statistical techniques in Meta-Stat are easy to misapply and misuse.***

Common Functions

Some functions are commonly available in the ***Meta-Stat*** statistical analyses. The following sections describe these functions.

You can also export data to analyzed with SPSS. *See Chapter 4 for more information.*

Selecting Variables to be Analyzed

After you select the statistical analysis you want to perform, ***Meta-Stat*** displays a selection window. This window contains fields where you identify the variables for the analysis.

---

[2] We do not provide ANOVA as we could not identify any algorithms that are appropriate for use with effect-sizes. For Plain Statistics, you can use dummy coding with the REGRESSION routine to perform ANOVA, ANCOVA, and t-tests. If your criterion variable is UNBIASED, the group MEANS routine will provide Hedges's homogeneity tests -- tests which are directly analogous to ANOVA. If your criterion variable is UNBIASED and you select WEIGHT as a weighting variable, the REGRESSION routine will give you Hedges's Q_E and Q_B and the corrected standard errors for the regression weights.

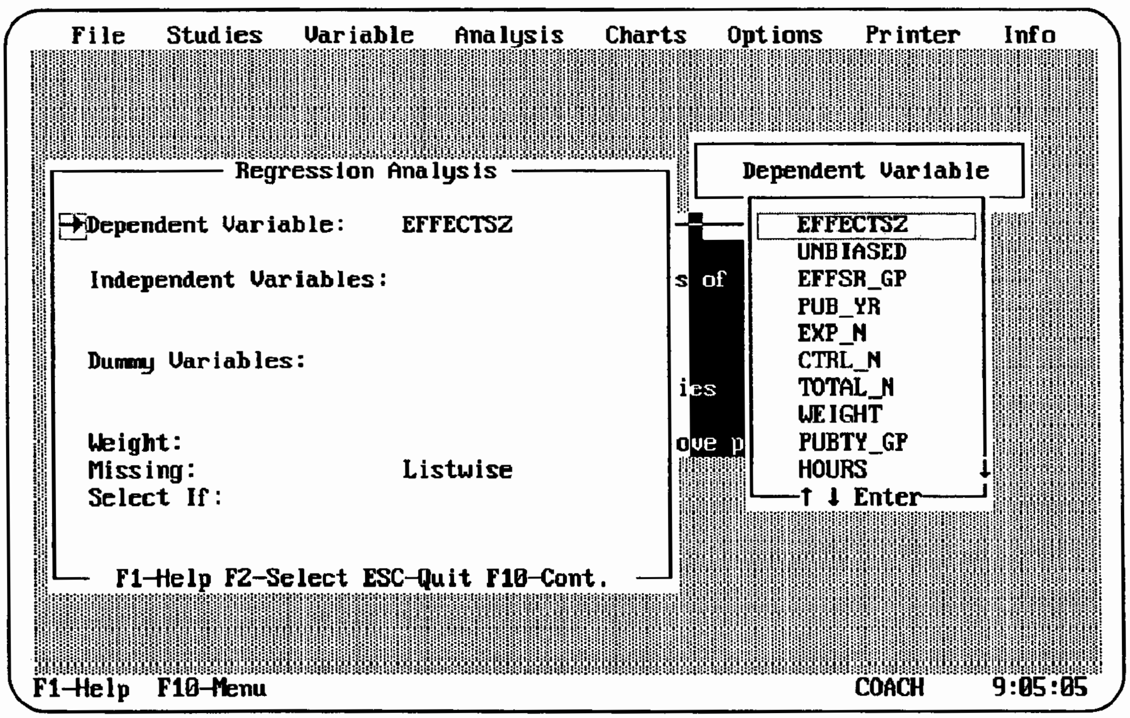
Selecting a Single Variable

For many analyses, you can select only a single variable in particular fields:

1. Highlight the desired field and press **Enter**.

   Meta-Stat displays a window that lists the variables that are appropriate for that field.

   In the following example from the Regression analysis, **Criterion Variable** was highlighted when Enter was pressed. In the window, *Meta-Stat* displays a list of variables:



2. To select a variable, highlight the variable in the list by moving the mouse or using ↓. Then press **Enter**.

   Meta-Stat returns you to the selection screen and fills in the field with the name of the variable you selected.

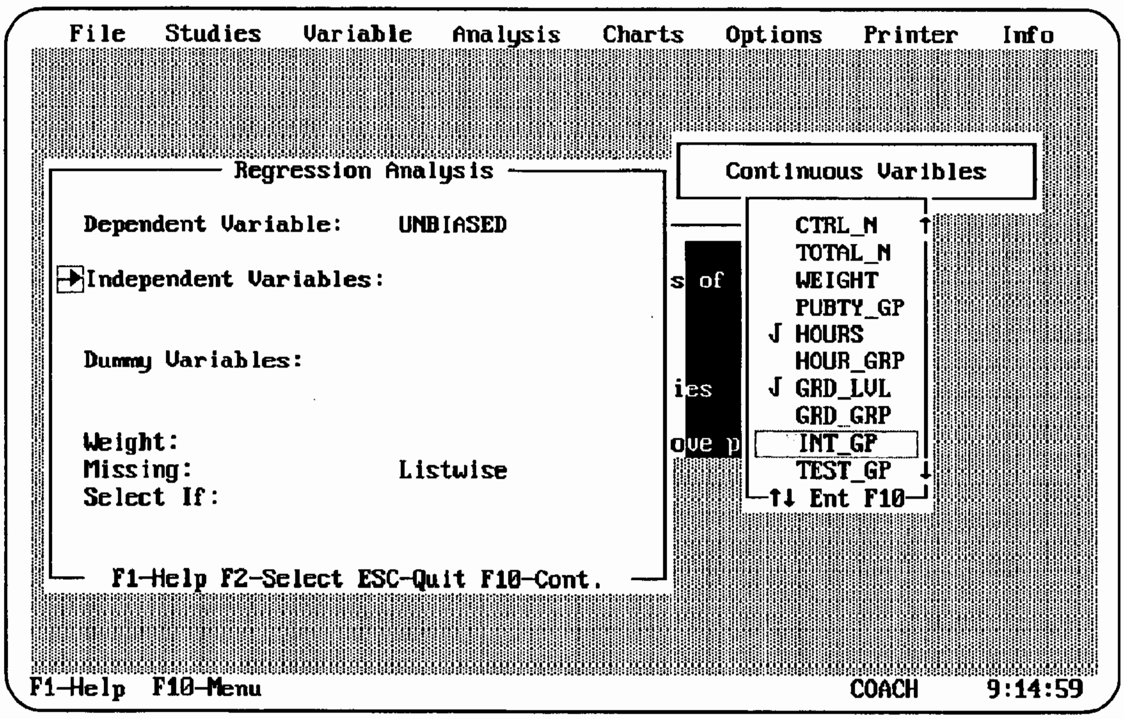
Selecting Multiple Variables

For some fields, you can select more than one variable. For example, you can identify more than one predictor variable for the Regression analysis. Follow these steps:

1. In the list of variables, move the pointer to the first variable you want to use and press **Enter**.

   Meta-Stat marks the variable with a check-mark.

2. Repeat step 1 until you have marked all the fields you want to use:

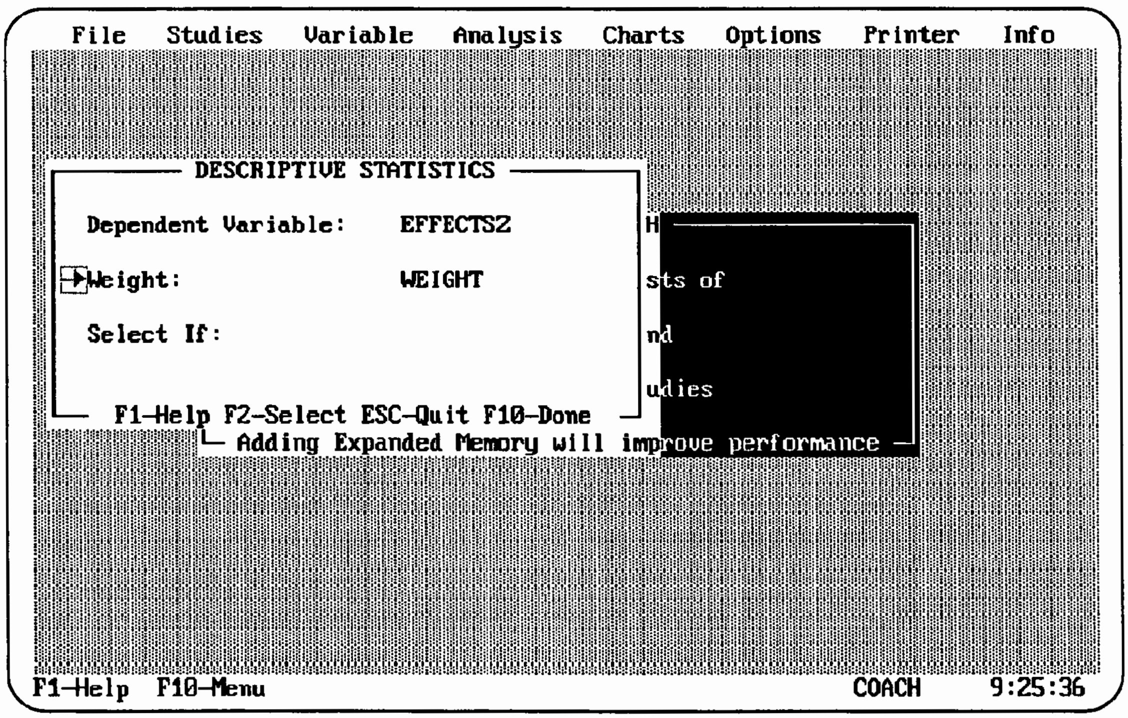


3. Press **F10** when you have finished. ***Meta-Stat*** returns you to the selection screen and fills in the field with the variable names.

Deselecting a Variable

Meta-Stat remembers the last variable(s) you selected. To deselect one or more variables, call up the list of variables and press **Esc**.

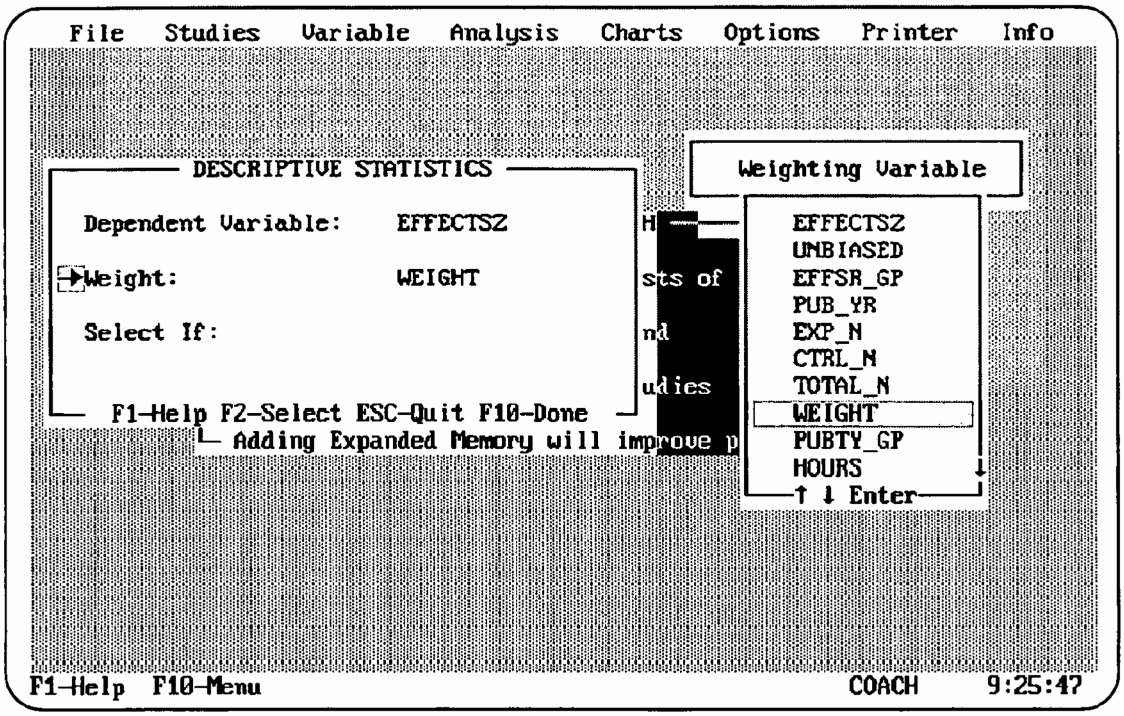
in the following example, the variable **WEIGHT** is currently selected as the weighting variable:



To deselect this variable:

1. Highlight the **Weight** field and press **Enter**.

   Meta-Stat displays a list of variables. The variable that is currently selected is highlighted.

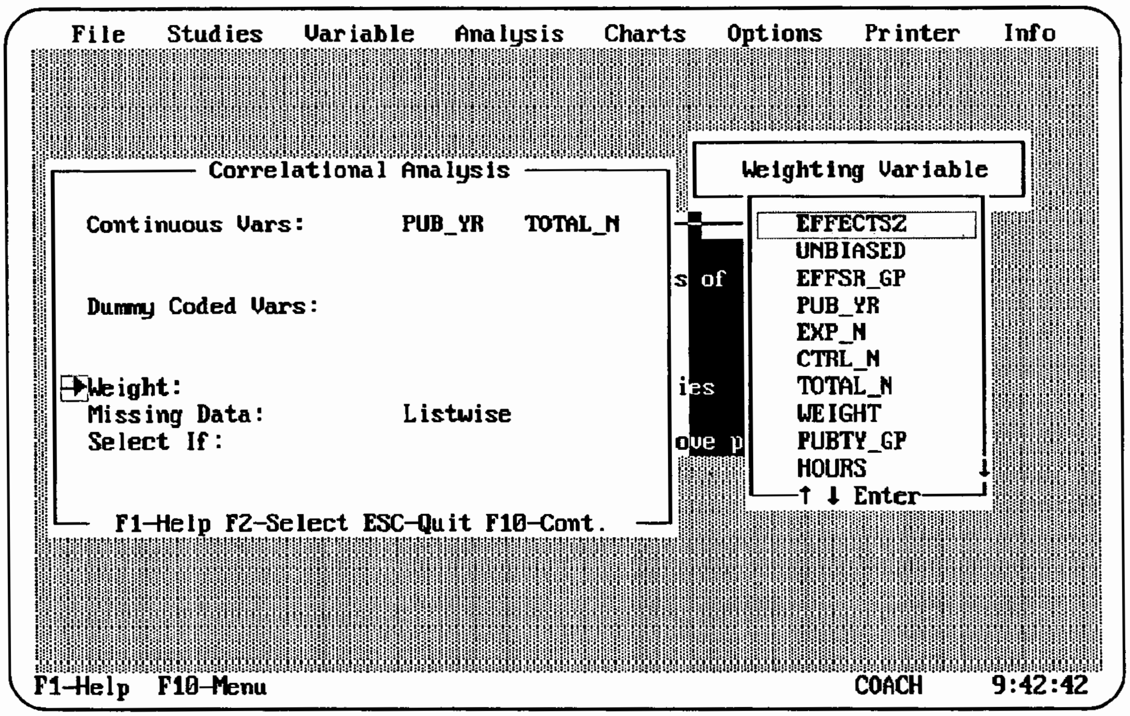


2. Press **Esc** to deselect the variable.

Weighting Your Data

You can weight your data using any variable. ***Meta-Stat*** includes a predefined variable called **WEIGHT** that you can use for this purpose. **WEIGHT** is an equation variable that equals the inverse of the variance. *See Chapter 5 for more information about this variable.*

To select the weighting variable, move the pointer to the **Weight** field and press **Enter**. Then select the variable you want to use:



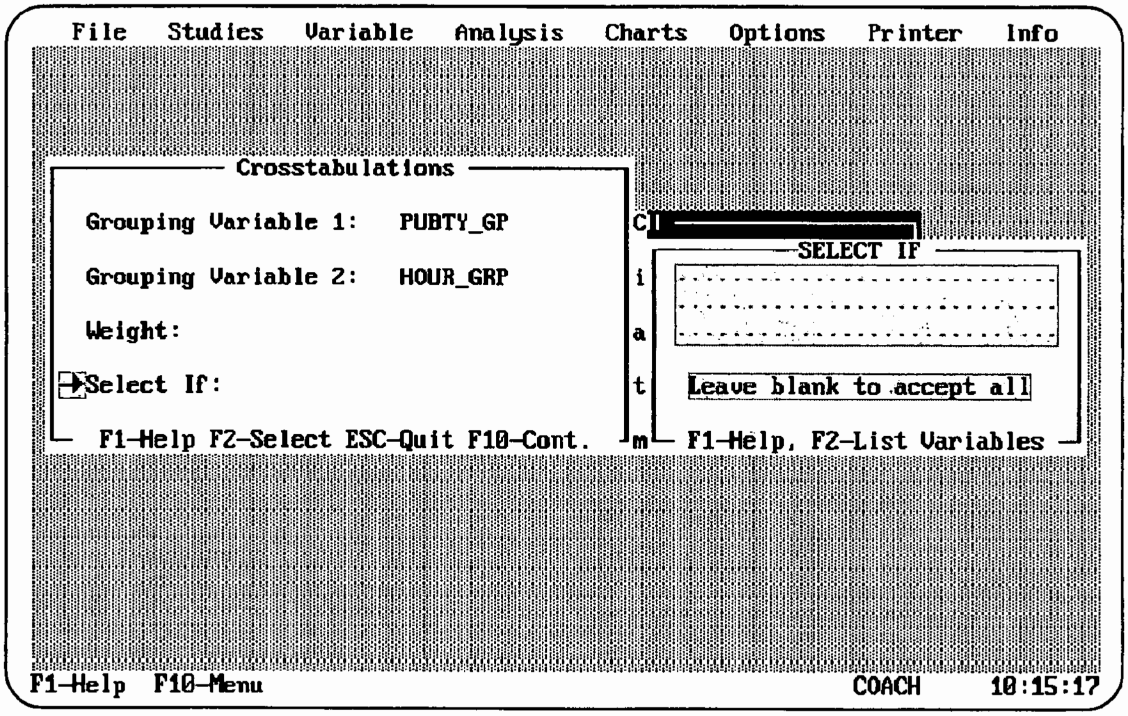
Selecting Data with a SELECT IF Statement

You can use a **SELECT IF** statement to limit the analysis to data meeting certain criteria. ***Meta-Stat*** will select for the analysis only the studies for which the IF statement is true.

For example, suppose you use a variable **QUALITY** to measure the quality of studies; a low-quality study is given a **QUALITY** value of 1. When you perform an analysis, you can use **SELECT IF** to trim the low-quality studies from the analysis by selecting only studies for which **QUALITY** is greater than 1.

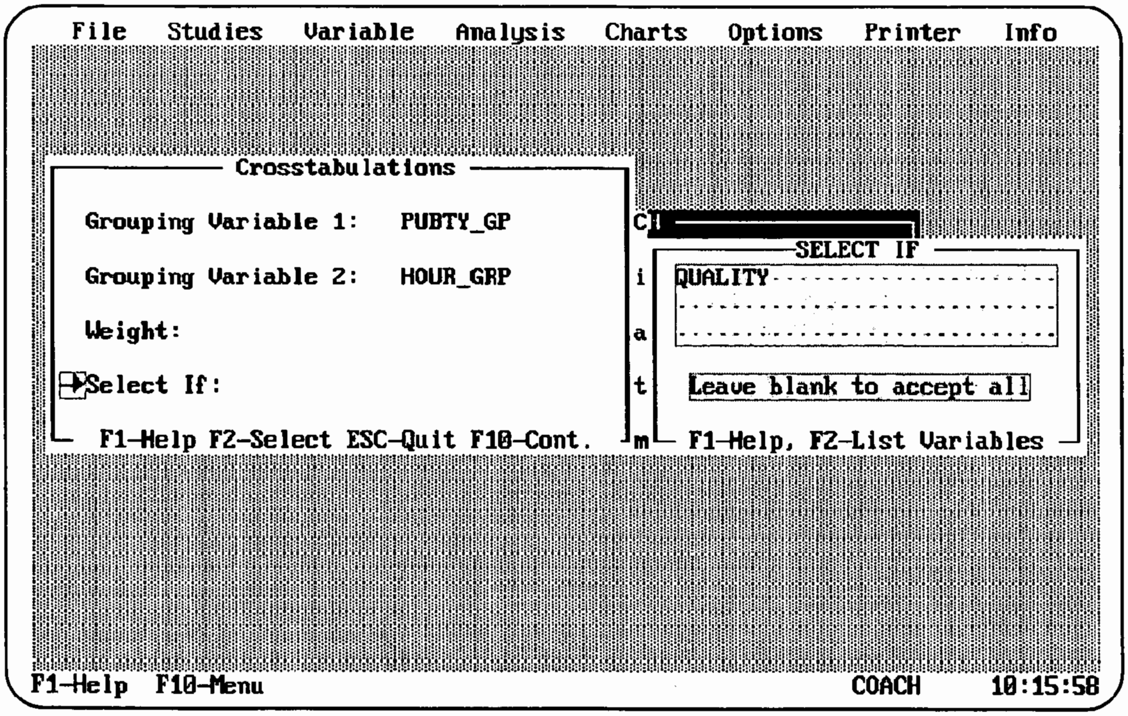
1. Move the pointer to **Select If** and press **Enter**.

Meta-Stat displays a window where you can enter selection criteria.



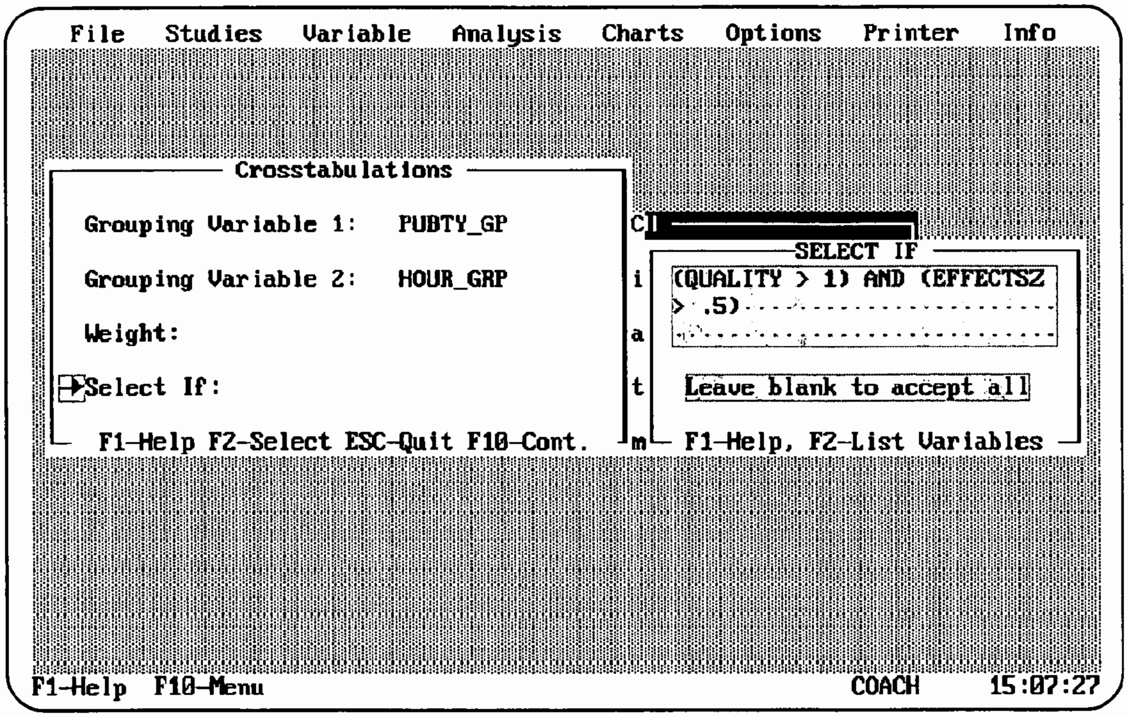
2. Press **F2** to display a list of variables.
3. In the list of variables, highlight the variable you want to use as part of the **SELECT IF** statement. Then press **Enter**.

Meta-Stat inserts the variable name in the selection criteria window:



4. Complete the **IF** statement by using parentheses, logical operators, and/or comparison operators. (Press **F1** to get more information about constructing an **IF** statement.)

In the following example, studies will be selected if the value of **QUALITY** is greater than 1 and if the value of **EFFECTSZ** is greater than 0.5:



Dealing with Missing Data

For the Regression and Correlation analyses, you can use the **Missing Data** field to tell ***Meta-Stat*** how to handle studies for which data are missing.

You can use two methods to handle missing data:

Method	**Description**
Listwise deletion	If a study does not have data for one of the variables, ***Meta-Stat*** ignores all other variables for that study. This is the default method.
Pairwise deletion	If a study does not have data for one of the variables, ***Meta-Stat*** still uses data for other variables in the study. **Caution:** Be careful when performing regressions without complete data. It is generally valid to do this only when you can assume that the data are missing randomly throughout the studies.

To identify the method you want to use, move the cursor to the **Missing Data** field and press **Enter**. Then select the method you want to use.

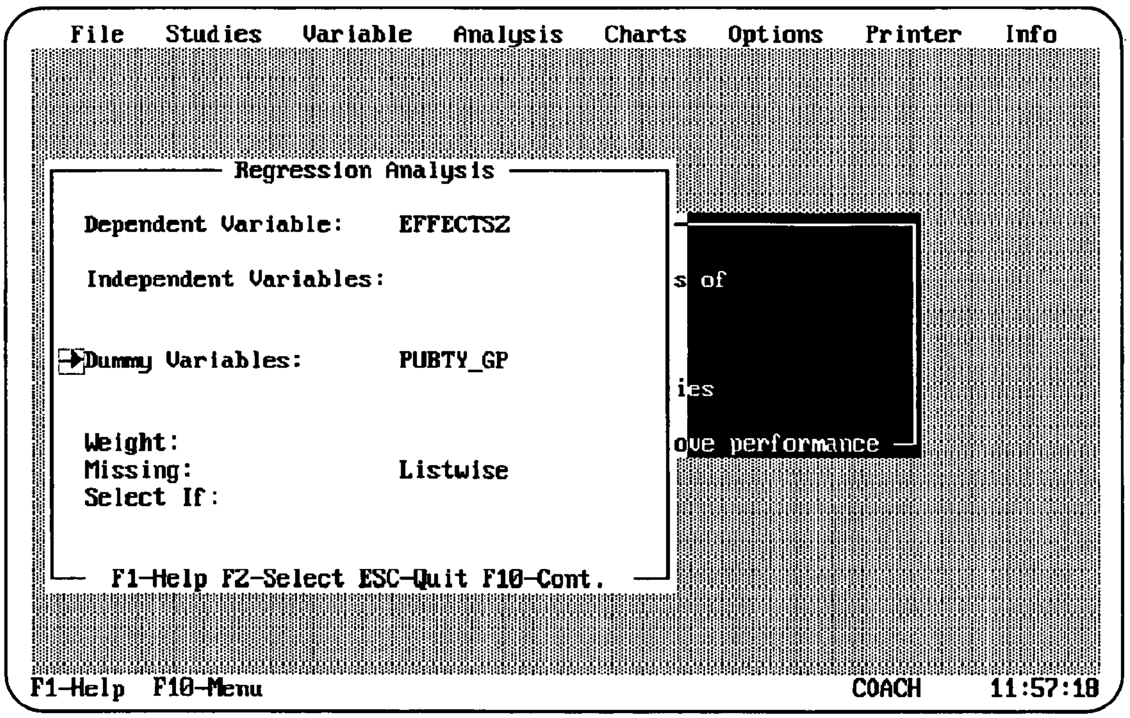
Using Dummy Variables

The Regression and Correlation analyses allow you to treat discrete and blocking data as dummy variables. For example, consider the discrete variable **PUBTY_GP**, which comes precoded with ***Meta-Stat***. When you enter data for a study, you use **PUBTY_GP** to identify where the study was published—in a Journal, Dissertation, Paper, Book, or Other place.

During a Regression or Correlation analysis, ***Meta-Stat*** can treat these five categories as separate variables by assigning scores of 1 and 0 to them. For example, a study that was published in a Journal receives a score of 1 for the dummy variable Journal; it receives scores of 0 for the dummy variables Dissertation, Paper, Book, and Other.

Dummy variables take their name because they are created only as a convenience, so that they can be inserted into equations that are necessary for the analysis.

Use the field **Dummy Variables** to identify the discrete or blocking data from which you want to create dummy variables. The following example uses **PUBTY_GP**:



The following example shows a portion of Regression results for which dummy variables were created from **PUBTY_GP**:

META-STAT 06/25/93

REGRESSION

Variable		Beta	B	St Err	t	p
PUBTY_GP	journal	0.000	0.000	0.230	0.000	—
PUBTY_GP	dissert	0.204	0.346	0.217	1.597	0.120
PUBTY_GP	paper	0.020	0.047	0.217	0.216	0.825
PUBTY_GP	other	0.615	1.664	0.454	3.663	0.002
Constant			0.536	0.124	4.334	0.000

Ctrl-P Print F10 Menu PgUp,PgDn MbCOACH 11:57:53

NOTE: To avoid the multicolinearity problem in computing regression weight standard errors the first group is dropped. Usually, this is the group with missing data.

Displaying Descriptive Statistics

When examining your meta-analysis data, one of your first tasks will be to explore the distribution of many of your variables.

The Descriptive Statistics analysis provides a basic description of a variable. The mean shows you the central tendency for a variable, while the standard deviation and variance describe the dispersion of data around the mean. These same statistics are calculated for the **Unbiased Effect Size variable.**

Follow these steps to perform the analysis:

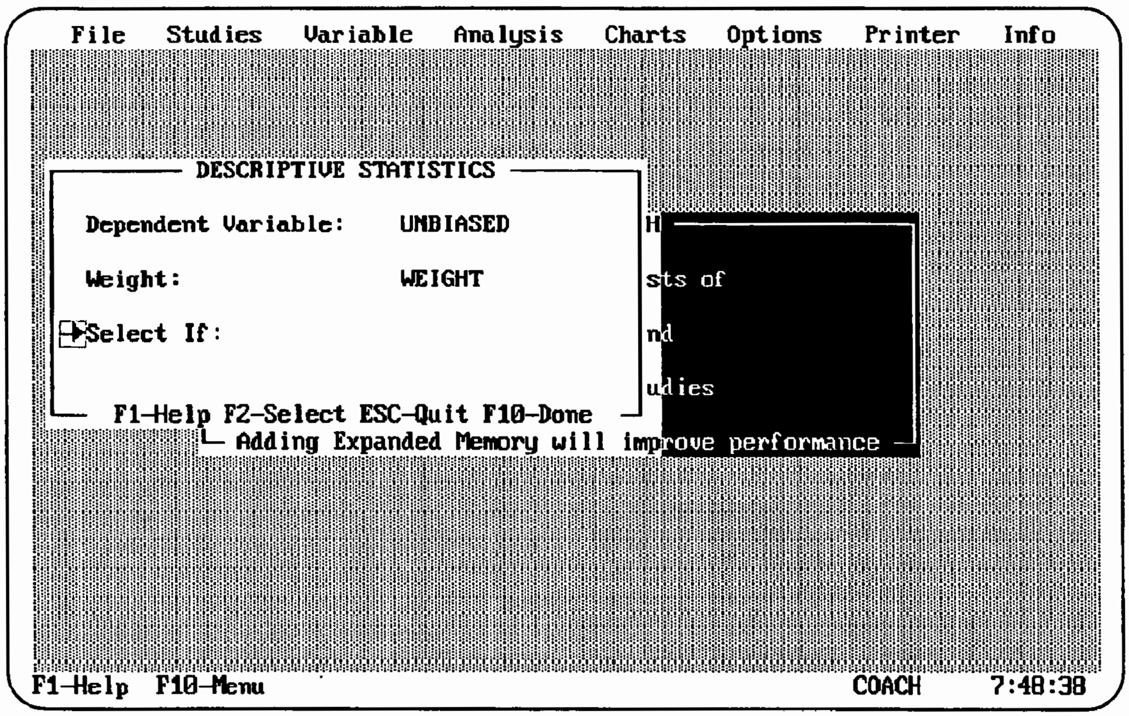
1. Select **Analysis/Descriptive**.

   Meta-Stat displays a screen where you can identify the variable you want to analyze.

2. Use **Criterion Variable** to identify the variable for which you want to display the statistics.

3. If necessary, identify a weighting variable and construct a **SELECT IF** statement. For more information, see "Common Functions" earlier in this chapter.

In the following example, ***Meta-Stat*** will display descriptive statistics for the **Unbiased Effect Size** variable (**UNBIASED**), using the **WEIGHT** variable for weighting:



4. Press **F10** to display the results.

Results Screen

```
META-STAT                                                        09/10/93
                  DESCRIPTIVE STATISTICS

     Criterion Variable:  UNBIASED   Unbiased Effect Size          ❶
     Weighting Variable:  WEIGHT     Inverse of the variance
     Select If:

     Number of Valid Observations:       29  ❷
     Number of Missing Observations:      1

                          unweighted    weighted

              Mean    |    0.591         0.891
        ❸   Median    |    0.479         0.479
          Variance    |    0.376         0.428
       Stand. Dev.    |    0.613         0.654
         Min Value    |   -0.287        -0.287
         Max Value    |    2.087         2.087
             Range    |    2.374         2.374
                      |
       ❹ Hedges's Ht       116.965   (p = 0.000)

Ctrl-P Print  F10 Menu  ↑↓ next variable   PgDn more                 22:26:48
```

This results screen:

❶ Identifies the variables you selected for the analysis and the SELECT IF statement you used to select data. The criterion variable is the criterion variable you selected.

❷ Lists the number of studies for which data were available for the criterion dependent) variable.

❸ Provides weighted and unweighted statistics for the criterion variable.

Value	Description
Mean	**Mean** value, equal to the sum of the values divided by the number of cases (studies). The mean is the most common measure of central tendency.
Median	**Median** value, which is either the value of the case that lies exactly on the 50th percentile, once the cases have been ordered by rank from highest to lowest, or the value that is half way between the two inner most cases.
Variance	The dispersion of values around the mean, roughly equal to the average squared deviation from the mean. The smaller the **variance**, the more homogeneous the data. This is the **variance** for the presented dataset, i.e., N is used as the denominator .
Stand. Dev.	**Standard deviation**, equal to the positive square root of the variance[3]
Min Value	**Minimum value** of the variable
Max Value	**Maximum value** of the variable
Range	The **range** between the minimum and maximum values

❹ If you used the **Unbiased Effect Size** as the criterion variable, ***Meta-Stat*** shows the results of Hedges's Homogeneity Test. This tests the hypothesis that the **Effect Sizes** for the studies are from different populations—that is, that they are not homogeneous. If the statistic is large (or equivalently if the value of p is low, say less than .05), Hedges's test indicates that there is a low probability that the **Effect Sizes** are from the same population. You can conclude that the effect sizes are homogeneous, i.e. the model of a single **Effect Size** is consistent with the data.

[3] To convert from the variance of a population to the unbiased population estimate based on a sample, multiply by ***n/(n-1)***.

Second Results Screen for Unbiased Effect Size

If you used the **Unbiased Effect Size** as the criterion variable, ***Meta-Stat*** shows a second screen of descriptive statistics. You can view this screen by pressing **PgDn** on the first screen.

```
META-STAT                                                            09/10/93
                        DESCRIPTIVE STATISTICS

     Criterion Variable:  UNBIASED   Unbiased Effect Size        ❶
     Weighting Variable:  WEIGHT     Inverse of the variance
     Select If:

     Number of Valid Observations:      29
     Number of Missing Observations:     1

                           unweighted          weighted
                     ------------------------------------
             Mean ES  |  0.591               0.891
     ❷   Fisher's Z  |  1.497 (p=0.13)      6.861 (p=0.00)
            Equiv ES  |  0.579               0.912
             Equiv R  |  0.278               0.415
          Equiv R SQ  |  0.077               0.172
          Failsafe N  |      0                 326
           Var Ratio  |  3.750              56.482

Ctrl-P Print  F10 Menu  ↑↓ next variable   PgUp basic                22:27:17
```

❶ Some information is repeated from the first results screen.

❷ The table presents the best estimate of the **Effect Size** for the population of studies.

Value	Description
Mean ES	Mean Effect Size
Fisher Z	A transformation that normalizes the **Effect Size** and provides a statistic that allows one to calculate the probability (p) of results under a null hypothesis of that the population **Effect Size** is zero.
Equiv ES	The equivalent **Effect Size** for the **Fisher Z**. This is the best estimate of the true **Effect Size** for this population of studies.
Equiv R	A correlation that is equivalent to **Equiv ES.**
Equiv R SQ	The amount of variance accounted for in the **Effect Size.**
Failsafe N	The number of studies with contradictory results that would have to be collected in order to reduce the probability of the combined findings to statistical insignificance at p=.05 (Rosenthal, 1990).
Variance Ratio	The ratio of the error variance to the variance of the **Effect Size**s. This provides a homogeneity measure. Schmidt and Hunter (1990, pages 281-338) state that you can conclude that the data are homogeneous, i.e., all the variance is due to forms of error, if the ratio is .75 or larger.

Performing a Regression Analysis

Use a regression analysis to investigate the relationship between predictor variables and a dependent or criterion variable, which is typically the **Effect Size**.

For example, in a meta-analysis of the effects of coaching on SAT scores, we might be interested in predicting the effects of coaching from predictor variables such as the number of hours of coaching and the grade level of the students. The regression analysis provides an equation that identifies how the values for hours and grade level must be weighted and summed to provide the best prediction of the coaching effects. The analysis also shows the accuracy of the equation and indicates how much of the variation in coaching effects is caused by hours and grade level.

To perform a regression analysis, follow these steps:

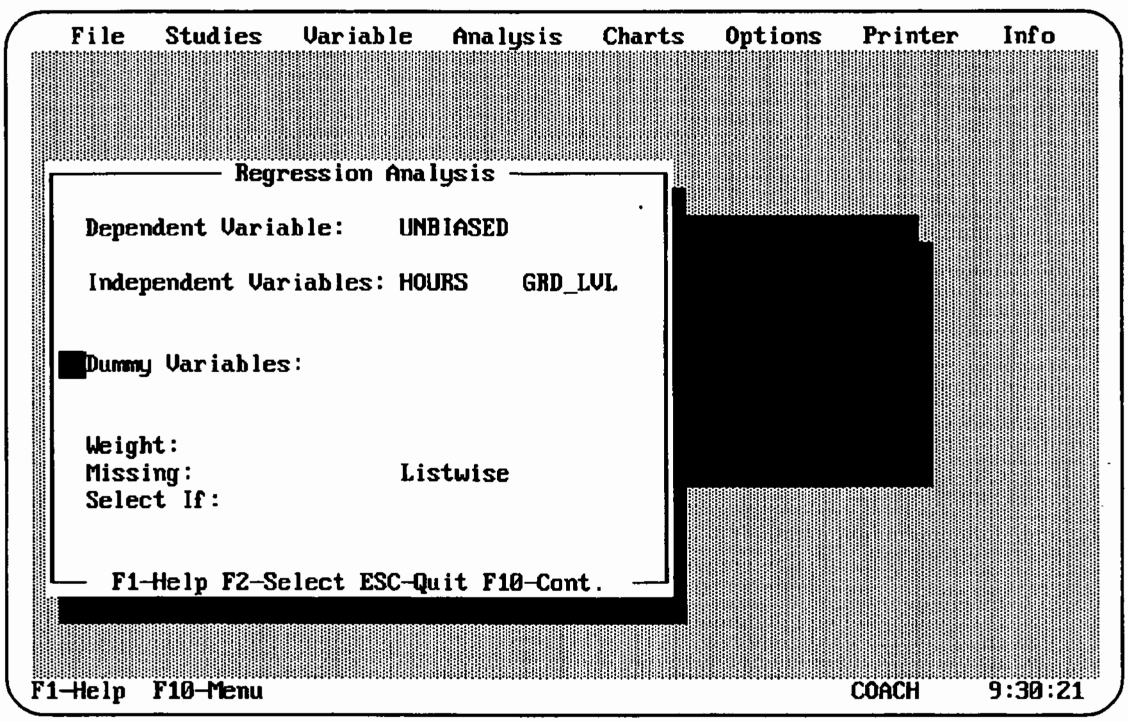
1. Select **Analysis/Regression**.

   Meta-Stat displays a screen where you can identify the dependent and predictor variables.

2. Use **Dummy Variables** to treat each category within a blocking or discrete variable as a dummy variable. For more information, see the section "Using Dummy Variables" earlier in this chapter.

3. If necessary, identify a weighting variable, a method to handle missing data, and construct a **SELECT IF** statement. For more information, see "Common Functions" earlier in this chapter.

   In the following example, a regression analysis will be performed to predict **Unbiased Effect Size** based on **Hours** and **Grade Level**:



4. Press **F10** to display the first screen of the analysis.

4. Press **F10** to display the first screen of the analysis.

First Results Screen: Summary Information

```
META-STAT                                                           09/10/93
 ------------------------------ REGRESSION ------------------------------
   Criterion Variable:        UNBIASED Unbiased Effect Size   1
   Predictor Variables:       HOURS    GRD_LVL
   Listwise deletion
   Solution took 2 iterations

 2    Multiple R              0.8791      R Square         0.7727
      Adjusted R-Square       0.7538      Standard Error   0.3176

                                      Sum of     Mean
                              DF     squares    square       F        p
                              --     -------    ------     -----    -----
   3     Regression            2      8.2299    4.1150    40.803   0.0000
         Residual             24      2.4204    0.1008
                                                                      4

Ctrl-P Print  F10 Menu                      PgDn More               22:29:21
```

This screen:

1 describes the variables you selected for the analysis and the method that ***Meta-Stat*** used to handle missing data.

2 describes the strength of the relationship between the predictor variable(s) and the criterion variable.

Value	Description
Multiple R	Correlation between predictors and the criterion variable. The magnitude **R** is an index of the strength of the relationship.
R Square	The square of **R**, indicating the amount of variance accounted for by the predictor variables. In the example above, 77 percent of the variation in **Unbiased Effect Size** is explained by the predictor variables.
Adjusted R Square	The adjusted **R Square** value.
Standard Error	The standard deviation of the differences between the actual and predicted values of the criterion variable (i.e., the standard deviation of the residuals).

❸ The summary table describes actual variances (mean squares) of the predicted values and the residual values.

❹ The p value is the probability that the observed degree of relationship, or one stronger, could have been obtained by sampling error from a population in which the multiple **R** is **0**.

Second Results Screen:
Coefficients and Standard Errors

To view the second screen of regression results, press **PgDn** on the first screen.

```
META-STAT                                                      09/10/93
                              REGRESSION

        Variable      Beta       B      St Err       t       p

  ❶     HOURS         0.168    0.191    0.170     1.125   0.271
        GRD_LVL       0.745    0.095    0.019     4.985   0.000
        Constant              -0.388    0.156    -2.483   0.019
                                                          ❷

Ctrl-P Print  F10 Menu                         PgUp,PgDn More   22:29:42
```

❶ Shows the following information for each prediction equation:

Value	Description
Constant	The predicted value of the criterion variable when the predictor variables are 0. In the example above, the predicted value for **Unbiased Effect Size** is -0.388 when the **HOURS** and **GRD_LVL** variables are 0.
Beta	The beta weight, or the standardized regression coefficient: This value is calculated after the dependent and predictor variables have been standardized to have unit variance (that is, a standard deviation of 1 for all variables). The standardized coefficients are useful when the predictor variables are measured in different units, such as a duration in hours and a study date in years. Using these coefficients allows one to compare the relative influence of each predictor variable (see Darlington, 1968). In the example above, the predicted **Unbiased Effect Size** increases by 0.168 standard deviation units for every increase of one standard deviation unit in the **HOURS** variable. The predicted **Unbiased Effect Size** increases by 0.745 standard deviation units for every increase of one standard deviation unit in the **GRD_LVL** variable.
B	The nonstandardized regression coefficient. This value indicates the expected change in the criterion variable with a change of one unit in the associated predictor. In the example above, the predicted **Unbiased Effect Size** increases by 0.191 for every unit increase in the **HOURS** variable, while the predicted **Unbiased Effect Size** increases by 0.095 for every unit increase in the **GRD_LVL** variable.
St Err	The standard error of each non-standardized regression coefficient. This value indicates the variability that would arise in **B** from repeated sampling and estimation of **B** with samples that are the same size as this one.

❷ The p value shows the probability of obtaining a beta this size or more discrepant from zero in sampling from a population in which the relevant beta is zero.

Third Results Screen: Correlations

To view the third screen of regression results, press **PgDn** on the second screen.

```
META-STAT                                                        09/10/93
                            REGRESSION

      Variable          R          Mean        St Dev      N

      UNBIASED        1.0000      0.5940      0.6400      27
      HOURS           0.7331      1.2926      0.5629      27    ❶
      GRD_LVL         0.8722      7.7407      5.0199      27

Ctrl-P Print  F10 Menu                        PgUp,PgDn More     22:30:17
```

❶ Provides a way to evaluate the contributions of each of multiple predictor variable to the *variation* in the criterion variable.

Value	Description
R	The correlation between the criterion and predictor variables. Larger numbers, approaching +1.0 or -1.0 indicate a stronger correlation. The sign of **R** indicates a positive or negative relationship.
Mean	The average value of the variable.
St Dev	The standard deviation for the variable. This is the square root of the unbiased population variance estimator (N-1 is the denominator).
N	The number of studies for which data were available.

Fourth Results Screen: Residuals

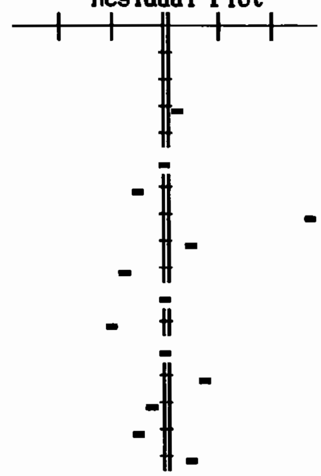
To display the fourth results screen, press **PgDn**. ***Meta-Stat*** asks if you want to record predicted values. If you answer **Y**,for "Yes", ***Meta-Stat*** will save the predicted values for the criterion variable in a new variable called **Y_HAT**. For more information, see the section below called "Recording Predicted Values."

META-STAT 09/10/93

REGRESSION

Study ID	❶ Y	❷ Y'	❸ Residual
ALLEN	0.9093	Missing	-----
BAJTEL1	Missing	1.6089	-----
BAJTEL2	0.4901	0.3728	0.1172
BAJTEL3	0.1915	Missing	-----
CALLEN	0.1946	0.1829	0.0117
COSTAR	0.1931	0.3161	-0.1230
CROZIER	0.9577	0.0880	0.8698
DILLAR	1.8817	1.7033	0.1784
EAKIN	0.4921	0.7532	-0.2611
EMERY	0.9897	0.9616	0.0281
GARLT	-0.2873	-0.0076	-0.2798
GROSS	0.8889	0.9043	-0.0154
JACOBS	1.3893	1.1897	0.1995
JOHNS	0.9909	1.0577	-0.0668
JONGS1	0.2873	0.4678	-0.1804
JONGS2	0.3831	0.2588	0.1243

❹ Residual Plot



Ctrl-P Print F10 Menu PgUp,PgDn More 22:39:07

❶ **Y** is the actual value of the criterion variable.

❷ **Y'** is the estimated or predicted value for the criterion variable, based on the predictors. This predicted value is saved in the new variable **Y_HAT**, if you told ***Meta-Stat*** to save the values.

❸ Residual is the difference between **Y** and **Y'**. This is the error in prediction. The closer the values are to the vertical axis, the smaller the error.

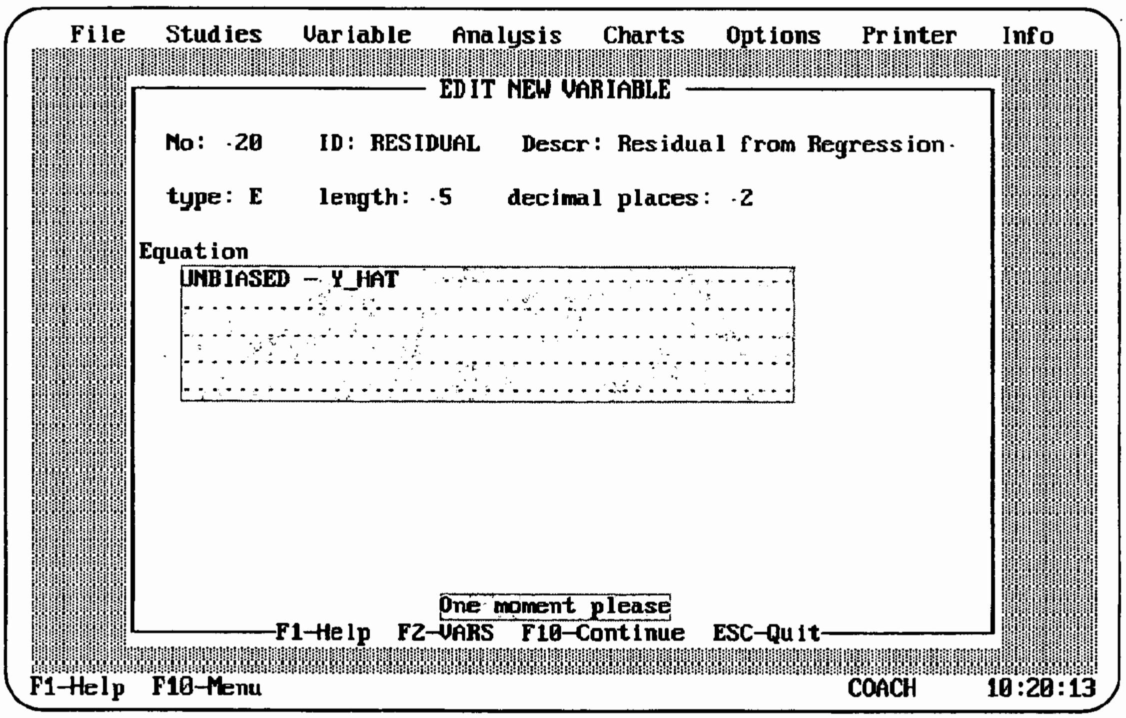
❹ ***Meta-Stat*** shows a plot of the residual values.

Recording Predicted Values

On the fourth results screen for the regression analysis, ***Meta-Stat*** asks:

Do you want to record predicted values?

If you answer **Y**, for "Yes", ***Meta-Stat*** will save the predicted values for the criterion variable—typically the **Effect Size**—in a new variable called **Y_HAT**.



You may then want to create a second new variable to hold the residual amount—that is, the difference between the predicted value for **Effect Size (Y_HAT)** and the actual value.

Plots of the residuals can help you assess whether your data meets the assumptions required of least squares regression analysis. We recommend the following plots (after Draper and Smith, 1966):

1. Bar Graph of the frequencies of the residuals values. If the model is correct, the plot should resemble observations drawn from a normal distribution with a zero mean. (Since an intercept is fit, the mean must be zero; but are the residuals normally distributed?)

2. Scatterplot of the residuals against **Y_HAT**.

3. Scatterplots of the residuals against each of the predictor variables.

If your plots show outliers or indicate possible curvilinear relationships, you may want to try one or more of the following:

a) Checking your data entry and evaluating the veracity of some data points.

b) Constructing a **SELECT IF** to trim suspicious datapoints.

c) Adding or removing predictor variables.

d) Transforming the criterion variable.

e) Transforming one or more predictor variables.

f) Adding a weighting variable.

g) Using Non-linear regression.

Using Dummy Variables to Explore Differences Between Groups

If you tell *Meta-Stat* to create dummy variables from a discrete or blocking variable, you can explore the differences between the groups identified by that variable.

The following example shows regression results for which dummy variables were created from the variable **PUBTY_GP**. The results permit the comparison of studies based on the place where the studies were published:

META-STAT 06/25/93

REGRESSION

Variable		Beta	B	St Err	t	p
PUBTY_GP	journal	0.000	0.000	0.230	0.000	—
PUBTY_GP	dissert	0.204	0.346	0.217	1.597	0.120
PUBTY_GP	paper	0.028	0.047	0.217	0.216	0.825
PUBTY_GP	other	0.615	1.664	0.454	3.663	0.002
Constant			0.536	0.124	4.334	0.000

Ctrl-P Print F10 Menu PgUp,PgDn MbCOACH 11:57:53

The summary table obtained when using Dummy coding is the same as the summary table that would be obtained from an analysis of variance or covariance. For more information about dummy variables, see the section "Using Dummy Variables" earlier in this chapter.

NOTE: If the criterion variable is **UNBIASED** and the weighting variable is **WEIGHT**, *Meta-Stat* follows the regression procedures for effect-sizes outlined in Hedges and Olkin (1985, 167-188). The sums of squares are reported as homogeneity statistics and are individually tested. The standard errors for the regression weights are corrected by dividing by the positive square root of the mean square error.

Testing Mean Differences Between Groups with Randomization

Using the **Randomization** analysis, you can test the mean differences between groups that are represented by discrete or blocking variables. **Randomization** is a useful tool because it makes no assumptions about the distribution of data, such as the normality assumption. Instead, the actual group of studies in hand is used for the analysis.

During the analysis, ***Meta-Stat*** calculates the mean value of the criterion variable for each group, then calculates the difference in means between the groups. Then ***Meta-Stat*** conducts up to 5,000 randomizing iterations to determine whether this actual difference is in fact unusual. During each iteration, ***Meta-Stat*** randomly draws groups from your group from the aggregate group of studies and calculates the differences in mean values for the groups.

After completing all iterations, ***Meta-Stat*** displays the probability of getting a difference in means that is equal to or larger than the actual difference. If the probability is high, you can assume that the actual difference in means is not unusual, because there is a high probability of finding this difference or one larger using randomly partitioned data. But if the probability is low, you can assume that the single obtained difference is unusual.

To use the Randomization analysis, follow these steps:

1. Select **Analysis/Randomization.**

   Meta-Stat displays a screen where you can identify the dependent and predictor variables.

2. Use **Criterion Variable** to identify the variable that you want to measure for the groups.

3. Use **Grouping Variable** to identify the discrete or blocking variable for which you want to test differences between groups.

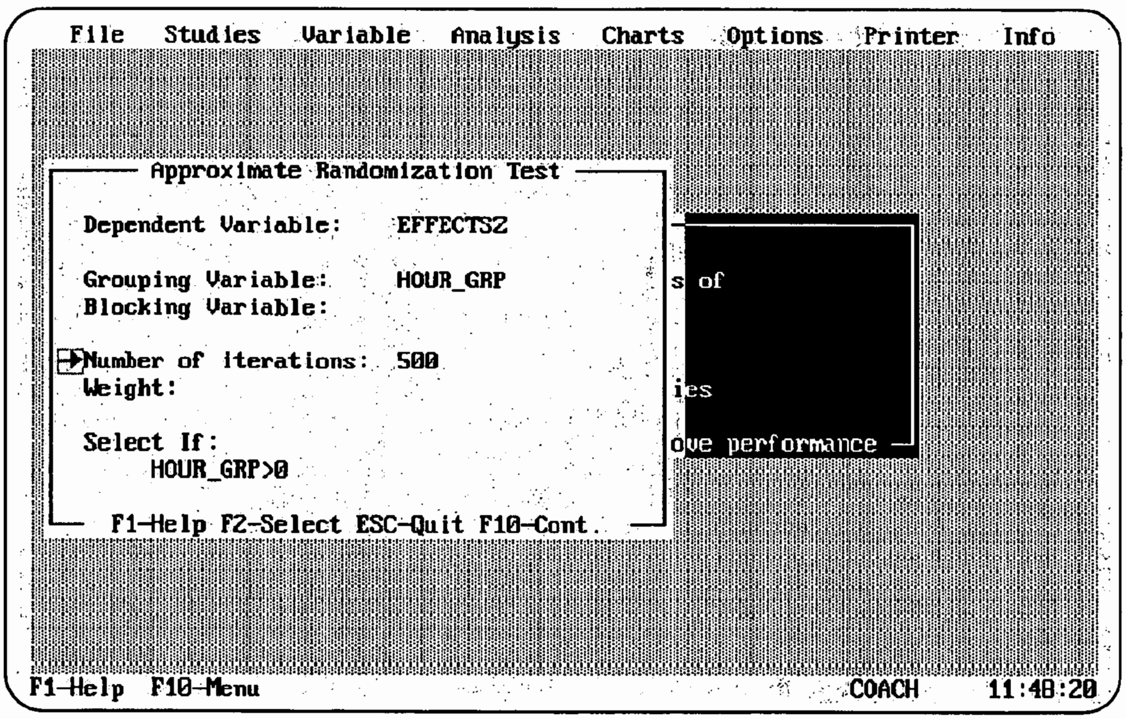
4. Optionally, use **Blocking Variable** to control for the effects of another variable without showing the variable on the results screen.

5. Select the **Number of Iterations** you want to use. Use fewer iterations when you are exploring. Use more iterations to get more precise results.

   Note that your results will be slightly different each time you perform the analysis, due to differences caused by randomization.

6. If necessary, identify a weighting variable, a method to handle missing data, and a **SELECT IF** statement. For more information, see "Common Functions" earlier in this chapter.

   In the following example, ***Meta-Stat*** uses 500 iterations to measure differences in **EFFECTSZ** between groups identified by the **HOUR_GRP** variable. In other words, the analysis will test whether the variable **HOUR_GRP** has some relationship to the value of **EFFECTSZ**.



7. Press **F10** to display the results of the analysis.

```
META-STAT                                                        09/10/93
          APPROXIMATE RANDOMIZATION TEST OF MEAN DIFFERENCES

 Criterion Variable  UNBIASED Unbiased Effect Size   1
 Grouping Variable   PUBYRGRP Year of publication
 30 Iterations
                               Mean Differences and (probabilities)
                                Means and sample size on diagonal
                         60-70    76-80    71-75     81+               2
         60-70          1.1459   0.5885   0.6136   1.0489
                           (5)  (0.129)  (0.129)  (0.032)
         76-80                   0.5574   0.0251   0.4605
                                   (15)  (0.968)  (0.226)
         71-75                            0.5322   0.4353
                                             (5)  (0.258)
         81+                                       0.0969
                                                      (4)

                                                                    Done.
 Ctrl-P Print  F10 Menu                                          22:39:59
```

During the analysis, ***Meta-Stat*** first calculated the mean **Effect Size** that was obtained for each group (as represented by the **HOUR_GRP** variable). ***Meta-Stat*** then calculated the difference in obtained means between each group.

Next, for each iteration of the analysis, ***Meta-Stat*** randomly selected studies from the entire collect of studies (28 in this example) to create three groups: one with 7 studies, a second with 16 studies, and a third with 5 studies. (Using this random partition ensures that, for the subsequent calculations, there is no difference between the groups.) For each group, ***Meta-Stat*** calculated the average **Effect Size**; it then calculated the differences between these averages. ***Meta-Stat*** then noted whether the difference was larger than the obtained difference between the actual groups. After the last iteration, ***Meta-Stat*** calculated the percentage of the iterations where the calculated difference was greater than the obtained difference. This is the probability that the obtained difference is a random occurrence.

❶ Identifies the variables and iterations you selected.

❷ Shows the obtained means, sample sizes, differences between means, and probabilities for the groups identified by the grouping variable. Referring to the example above:

- Obtained means and sample sizes for each group are shown along the diagonal. The actual mean Effect Sizes for the Long, Normal, and Short groups are 1.4250, 0.4953, and 0.3540, respectively.

  The sample sizes for the Long, Normal, and Short groups are 7, 16, and 5.

- The difference between the obtained mean **Effect Size** for the Normal group (0.4953) and the obtained mean **Effect Size** for the Short group (0.3540) is (0.1413). In the Randomization analysis, ***Meta-Stat*** calculated that, over 500 iterations, there is a probability of approximately 65 percent that you would obtain this large a difference in **Effect Size** with randomly drawn data. In other words, the observed difference in **Effect Size** between these two groups is not unusual; there is a high probability of seeing this difference using randomly partitioned data.

- By contrast, the difference between the obtained mean **Effect Size** for the Normal group (0.4953) and the obtained mean **Effect Size** for the Long group (1.4250) is (0.9297). In the Randomization analysis, ***Meta-Stat*** calculated that, over 500 iterations, there is a probability of well under 1 percent (0.002) that one would obtain a difference this large with randomly partitioned data. In other words, the actual observed difference between these two groups is unusual, and one can assume that there is in fact some difference between these groups.

NOTE: The approximate randomization test will tell whether the variables are independent. It is only appropriate for making inferences about a population when the data have been randomly selected.

Showing Correlations Between Variables

Use a **Correlation Analysis** to investigate the relationship between variables. The analysis shows the degree to which variation in one variable is related to variation in another.

Correlations can be positive or negative. A positive correlation means that a pair of variables tends to increase and decrease together. A negative correlation indicates an inverse relationship, in which one variable increases as another decreases. The size of the correlation measures the strength of the relationship. A correlation of 1 indicates a perfect linear relationship between the variables. **Correlations** that are close to 0 indicate little or no linear relationship.

Correlation Analysis provides a good starting point for other analyses, including **Regression**. After using **Correlation** to discover strong relationships between variables, you can use **Regression** to calculate prediction equations for the variables.

To perform a **Correlation Analysis**, follow these steps:

1. Select **Analysis/Correlation**.

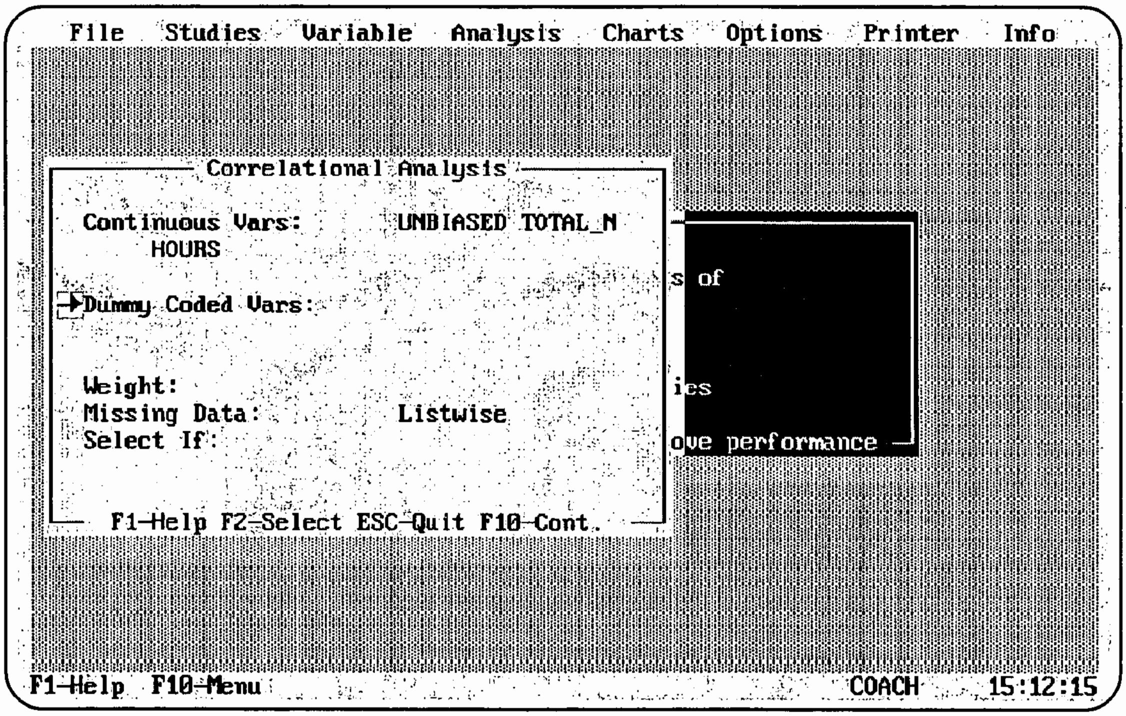
   Meta-Stat displays a screen where you can identify the variables you want to use.

2. Use **Continuous Vars** to identify continuous or equation variables for the analysis.

   Use **Dummy Coded Vars** to identify blocking or discrete variables for the analysis. ***Meta-Stat*** will treat each category within the variable as a separate dummy variable for the analysis. *For more information, see the section "Using Dummy Variables" earlier in this chapter.*

3. If necessary, identify a weighting variable, a method to handle missing data, and a **SELECT IF** statement. *For more information, see "Common Functions" earlier in this chapter.*

In the following example, a Correlation analysis will be performed on **Unbiased Effect Size**, **Hours**, and **Total Sample Size (TOTAL_N)**:



4. Press **F10** to display the results.

```
META-STAT                                                      09/10/93
                    CORRELATIONAL ANALYSIS
 Listwise deletion

                          Correlation Matrix and Sample size (N)

                    UNBIASED   TOTAL_N    HOURS

 UNBIASED             1.0000    0.8956   0.7331
                       (27)      (27)     (27)     ❶
 TOTAL_N                        1.0000   0.6604
                                 (27)     (27)
 HOURS                                   1.0000
                                          (27)

                                                                  Done.
Ctrl-P Print   F10 Menu                                        22:43:54
```

❶ The screen shows the correlation coefficient between each pair of variables. In the example above, the correlation between **Hours** and **Unbiased Effect Size** is relatively strong (0.5406), while the correlation between **TOTAL_N (Total Sample Size)** and **Unbiased Effect Size** is weak (0.2423) . Larger numbers indicate a stronger correlation, with 1 meaning a perfect correlation and 0 meaning no linear correlation.

The number in parentheses identifies how many studies were used for the sample. This number is determined by the number of studies in your meta-analysis and the method you used to handle missing data. For more information, see "Common Functions" earlier in this chapter.

HINT: The correlation coefficient measures only linear (i.e., straight line) relationship between two variables. It is possible, though unlikely, that two variables can be perfectly curvilinearly related and yet their correlation equals 0.

To detect curvilinear relationships, you should inspect the Scatterplot option (*see Chapter 8*). When variables are curvilinearly related, you may wish to consider a transformation to "linearize" them before performing multiple regression analyses.

Cross-Tabulating Groups

Use a Cross-Tabulation analysis to investigate the relationship between two discrete or blocking variables.

The analysis displays a two-way table that shows the joint frequency distribution. You can use the table to review the distribution of values for the two groups. The analysis also provides a measure of statistical significance, to help you determine if the variables are statistically independent.

To perform a cross-tabulation, follow these steps:

1. Select **Analysis/CrossTabs**

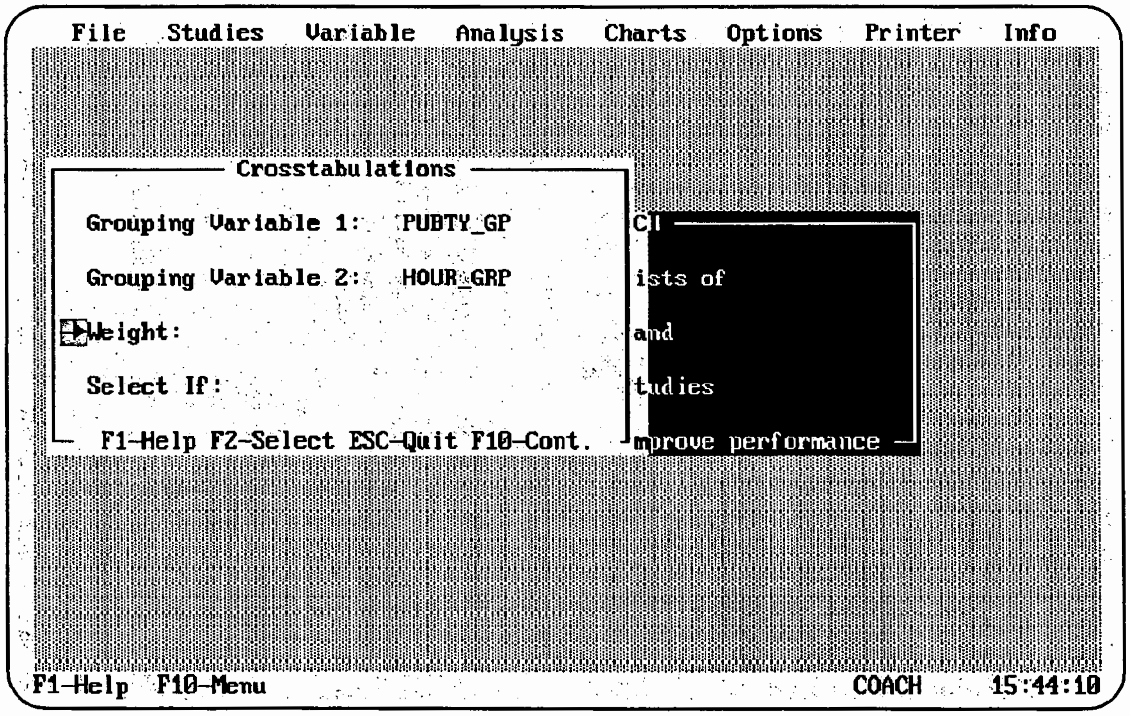
   Meta-Stat displays a screen where you can identify the variables you want to use.

2. Use **Grouping Variable 1** to identify the discrete or blocking variable that you want to use as the column variable in the two-way table.

3. Use **Grouping Variable 2** to identify the discrete or blocking variable that you want to use as the row variable in the table.

4. Optionally, identify a weighting variable and construct a **SELECT IF** statement. *For more information, see "Common Functions" earlier in this chapter.*

In the following example, a cross-tabulation will be performed using grouping variables for **Publication Type** and **Hours**:



4. Press **F10** to display the results.

Results Screen

```
META-STAT                                                       09/10/93
                         CROSSTABULATIONS
  PUBTY_GP  Publication Type          Valid Observations: 30   ❶
by HOUR_GRP Duration of program

                   Observed (and Expected) Frequencies
                           Publication Type
                   0         1         2         3         5          Row
Duration of      Missing   journal   dissert   paper     other       Total

0  Missing         0         0         1         1         0          2.00
                 (0.07)    (1.00)    (0.40)    (0.40)    (0.13)
1  short           0         2         1         2         0          5.00
              ❷  (0.17)    (2.50)    (1.00)    (1.00)    (0.33)
2  average         1         11        2         1         0         15.00
                 (0.50)    (7.50)    (3.00)    (3.00)    (1.00)
3  long            0         2         2         2         2          8.00
                 (0.27)    (4.00)    (1.60)    (1.60)    (0.53)

Column Total      1.00      15.00     6.00      6.00      2.00       30.00

Ctrl-P Print  F10 Menu  ↑↓ new grp 1  ↔ new grp 2                 22:44:28
```

❶ Identifies the variables you selected for the analysis, along with the number of studies for which data were available.

❷ Shows the tabulated results, with row and column totals. The numbers in parentheses show the values that would be expected, given the row and column totals, if there were no relationship between the variables. Large differences between the observed and expected values may indicate a systematic relationship between the variables.

Cross-Tabulating for Other Groups

From the results screen, you can quickly flip through cross-tabulations for other groups in your meta-analysis. Press ↑ or ↓ to select a new column variable. Press the ← or → cursor key to select a new row variable.

Calculating Group Means

Use a Group Means analysis to calculate means for members of categories, or groups, that are identified by a discrete or blocking variable. The analysis provides you with the mean, standard deviation, and 95 percent confidence intervals. If you use **Unbiased Effect Size** as the criterion variable, the Group Means analysis also provides homogeneity measures.

To use the Group Means analysis, follow these steps:

1. Select **Analysis/group Means**

   Meta-Stat displays a screen where you can identify the variables you want to use.

2. Use **Criterion Variable** to identify the variable that you want to measure for each group. Typically, this is the **Effect Size**.

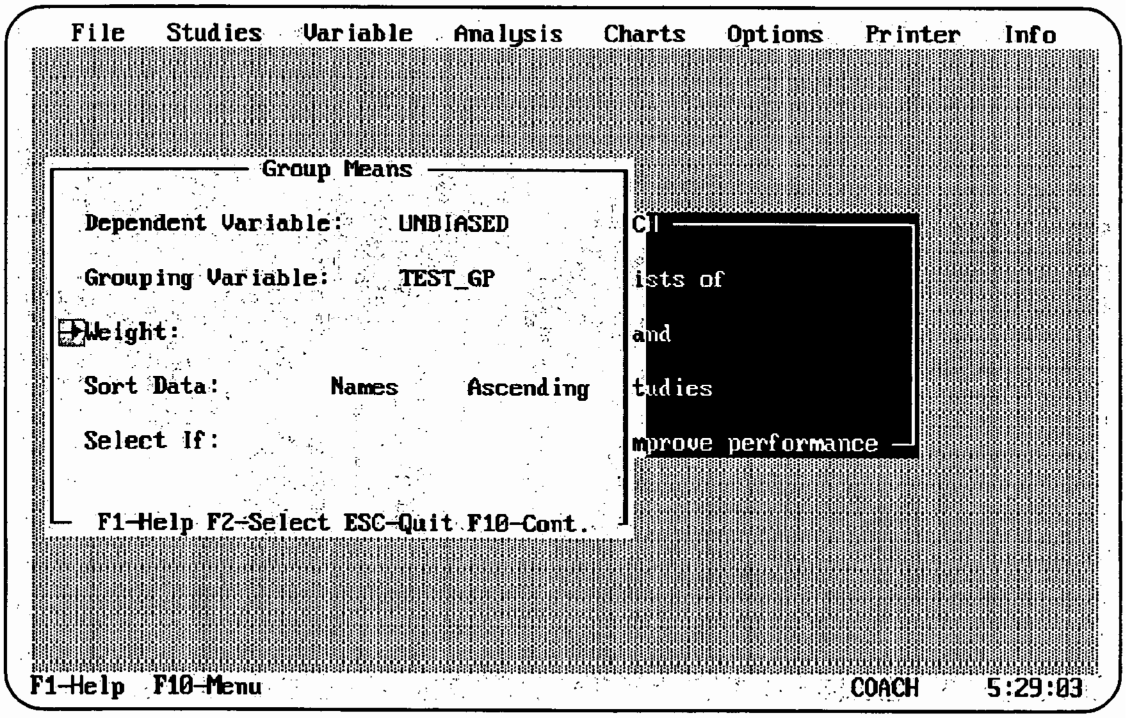
3. Use **Grouping Variable** to identify the discrete or blocking variable for which you want to calculate the means.

   Leave this field blank to calculate means for all discrete and blocking variables.

4. If you left **Grouping Variable** blank, use the **Sort Data** field to identify a sorting sequence for the group members that ***Meta-Stat*** will display.

5. Optionally, identify a weighting variable and construct a **SELECT IF** statement. *For more information, see "Common Functions" earlier in this chapter.*

In the following example, ***Meta-Stat*** will calculate the mean **Effect Size** for the **TEST_GP** variable:



6. Press **F10** to display the results.

Results Screen

```
META-STAT                                                      09/10/93
                          GROUP MEANS
 Criterion Variable:  UNBIASED
                                   ❶

                                 Mean    St. Dev.    N  95% Confid Interval
TEST_GP  Test constructer
             1   teacher         0.793     0.633     6    0.161 to 1.425
             2   standardi       0.672     0.702    11    0.206 to 1.138
      ❷      3   other           0.416     0.547    12    0.071 to 0.760

                         ❸
                    Hedges's Homogenity Tests
                    Source   Statistic   df
                    Total     116.965   28  (p = 0.000)
                    Within    107.799   26  (p = 0.000)
                    Between     9.166    2  (p = 0.010)

Ctrl-P Print  F10 Menu                                         22:46:34
```

❶ This screen identifies the criterion variable you are measuring for each group member.

❷ For each group member, ***Meta-Stat*** displays the following information:

Value	**Description**
Mean	**Mean** value, equal to the sum of the values divided by the number of cases (studies). The **mean** is the most common measure of central tendency.
Stand. Dev.	**Standard deviation**, equal to the positive square root of the variance. (The variance is a measure of the dispersion of values around the mean, roughly equal to the average squared deviation from the mean.) The smaller the **standard deviation**, the more homogeneous the data.
N	Number of group members
95% Confid Int.	The 95 percent confidence intervals for the group means.

❸ Hedges's Homogeneity Test measures the total variation among the groups, as well as the variation within and between the groups, to test the hypothesis that the **Effect Sizes** come from the same population—that is, that they are homogeneous. If the statistic is large (or equivalently if the value of p is low, say less than .05), Hedges's test indicates that there is a low probability that the Effect Sizes are from the same population.

Hedges and Olkin note (1985, pages 157-159) that the homogeneity statistics can be used for fitting models to effect size for groups in a procedure that is analogous to the procedure used to fit hierarchical log-linear models to contingency tables. They outline a strategy similar to the following:

<u>Step 1:</u> Look at the total homogeneity statistic (Q_T). If the value is not large, i.e. is not statistically significant, then you are done. You can conclude that the model of a single **Effect Size** fits the data.

<u>Step 2:</u> If Q_T is large, then look at the within homogeneity statistic, Q_W. If Q_W is not statistically significant, then you can you can conclude that the model of a different **Effect Size** for each of your groups adequately fits the data. The between

fit statistic, Q_B, indicates the extent to which the effect sizes differ among groups.

A large value of Q_W indicates that effect sizes are not homogeneous within the groups. You should redefine your groups, either through secondary classifications, using a different grouping variable, creating new groups, or using the **SELECT IF** feature. Then again, compute Q_W.

Results Screen for All Grouping Variables

If you did not specify a grouping variable, ***Meta-Stat*** shows results for all discrete and blocking variables. Use **PgDn** to move from one screen to the next:

NOTE: If you are interested in analyzing the **UNBIASED Effect Size** as the criterion variable, ***Meta-Stat*** will compute Hedges's homogeneity statistics. You do not need to specify **WEIGHT** as a weighting variable as this is done internally to perform the necessary calculations.

Calculating Frequencies

Use Frequency analysis to count the number of different values for a variable and display the frequency at which each value occurs. This analysis gives you a clear picture of the breakdown of data for a variable.

Follow these steps:

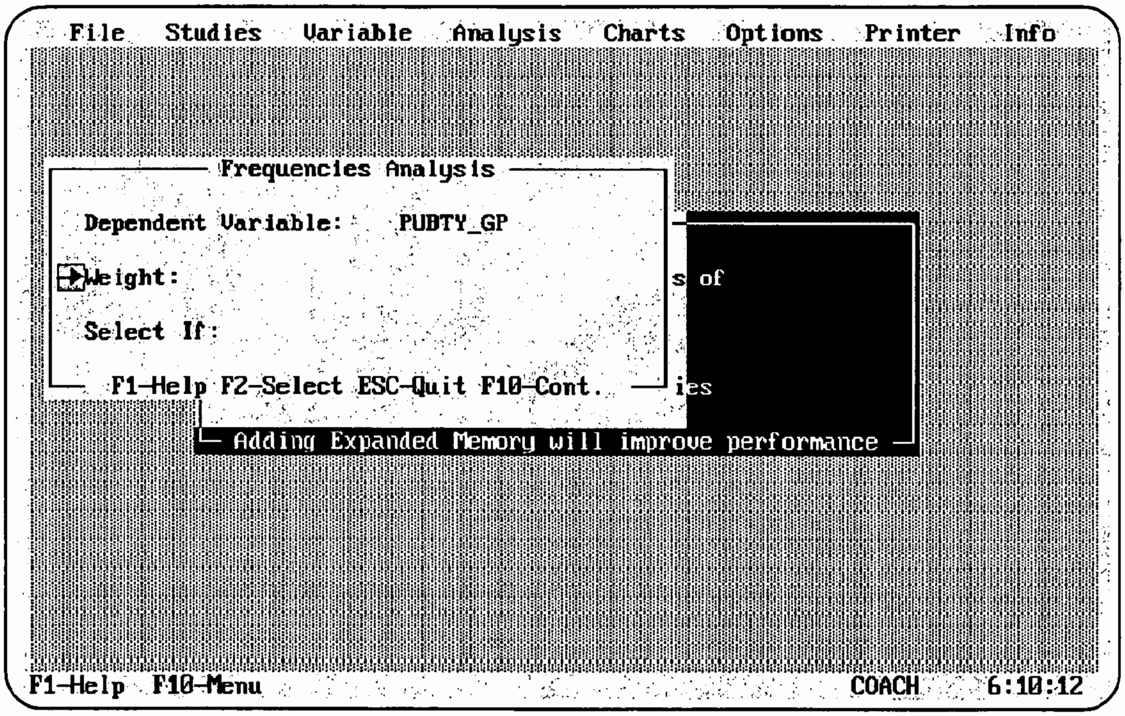
1. Select **Analysis/Frequencies**

   Meta-Stat displays a screen where you can identify the variable you want to count.

2. Use **Criterion Variable** to identify the variable that you want to count. This can be any type of variable.

3. If necessary, identify a weighting variable and construct a **SELECT IF** statement. *For more information, see "Common Functions" earlier in this chapter.*

In the following example, ***Meta-Stat*** will count **PUBTY_GP**:



4. Press **F10** to display the results.

META-STAT — 09/10/93

FREQUENCIES

Criterion Variable: PUBTY_GP Publication Type — N of Cases: 30

❶

Value	Label	Cases	Sum of Weights	Relative Frequency	Adjusted Frequency
	Missing	1	1.000	3.3%	——
1	journal	15	15.000	50.0%	51.7%
2	dissert	6	6.000	20.0%	20.7%
3	paper	6	6.000	20.0%	20.7%
5	other	2	2.000	6.7%	6.9%

❷

Done.

Ctrl-P Print F10 Menu — 22:47:10

The results screen:

❶ Identifies the variable you are measuring.

❷ Displays the following information for each value of the variable:

Value	Description
Value	A value for the variable.
Label	For discrete and blocking variables only, shows the label attached to the value.
Sum of Weights	The sum of the weighting data that you used, if any.
Relative Frequency	The relative frequency with which the value occurs.
Adjusted Frequency	The relative frequency with which the value occurs, adjusted after removing missing values.

Displaying Means for a Two-Way Breakdown of Groups

The **Breakdown** analysis is similar to the **Cross-Tabulation** analysis in that it provides a two-way breakdown of grouping variables. However, the **Breakdown** analysis provides more detail on the data by calculating, for each two-way breakdown, the mean for the criterion variable. For example, where **Cross-Tabulation** provides you with the number of cases for each two-way breakdown, the **Breakdown** analysis calculates means for the criterion variable for each two-way breakdown.

To perform the analysis, follow these steps:

1. Select **Analysis/Breakdown**

   Meta-Stat displays a screen where you can identify the variables you want to use.

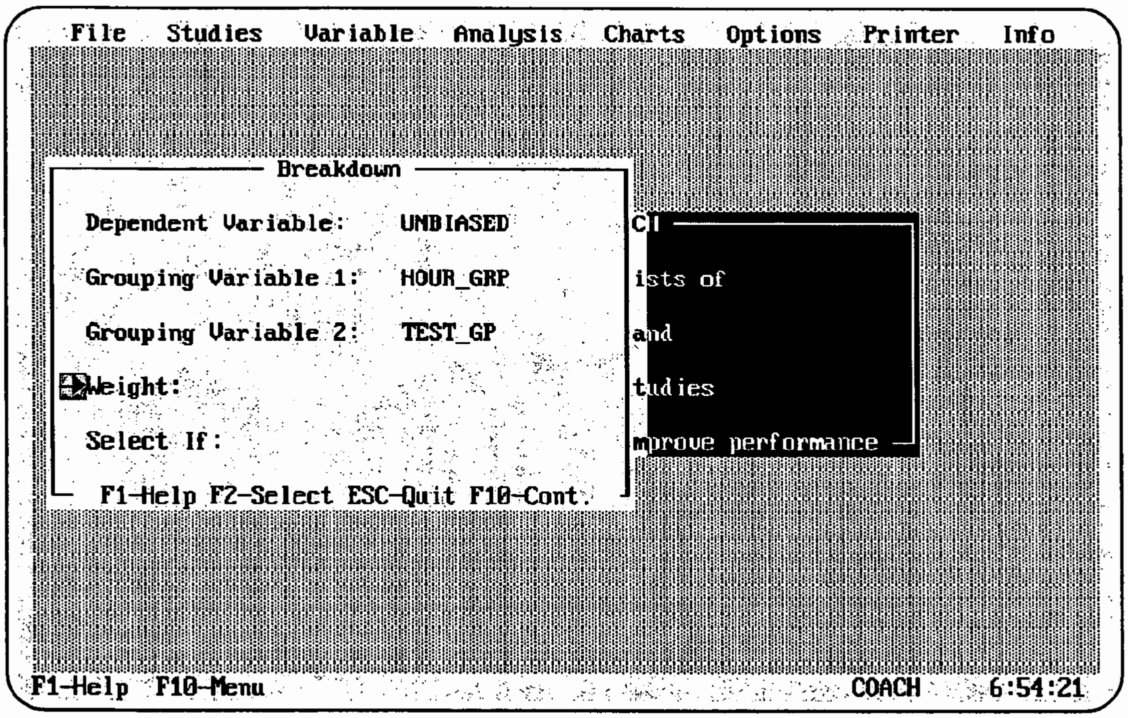
2. Use **Criterion Variable** to identify the variable you want to count.

3. Use **Grouping Variable 1** to identify the discrete or blocking variable that you want to use as the column variable in the two-way table.

4. Use **Grouping Variable 2** to identify the discrete or blocking variable that you want to use as the row variable.

5. Optionally, identify a weighting variable and constructing a **SELECT IF** statement. *For more information, see "Common Functions" earlier in this chapter.*

   In the following example, ***Meta-Stat*** will calculate the mean **Effect Size** for each cell in the two-way breakdown of **HOUR_GRP** and **TEST_GP**:



5. Press **F10** to display the results.

Results Screen

```
META-STAT                                                           09/10/93
                              BREAKDOWN
   UNBIASED  Unbiased Effect Size      Valid Observations: 29
by HOUR_GRP  Duration of program  ❶
   TEST_GP   Test constructer
                         Means (and Cell Sizes)
                          Duration of program
                      0        1         2          3            Row
 Test constr      Missing    short    average     long          Total
 ----------------------------------------------------------------------
 1  teacher         0.909              0.325      1.436         0.793
                     (1)                (3)        (2)           (6)
 2  standard        0.192      ❷       0.462      1.322         0.672
                     (1)                (7)        (3)           (11)
 3  other             .       0.178    0.428      0.980         0.416
                               (5)      (5)        (2)           (12)
 ----------------------------------------------------------------------
 Column Total       0.550     0.178    0.423      1.257         0.591
                     (2)       (5)      (15)       (7)           (29)

Ctrl-P Print  F10 Menu  ↑↓ new grp 1  ↔ new grp 2                   22:47:44
```

The results screen:

❶ Identifies the variables you selected for the analysis, along with the number of studies for which data were available.

❷ Shows the tabulated results for each breakdown, along with means for each row and column. The numbers in parentheses show the cell sizes. For example, in studies where teachers devised tests, the mean **Effect Size** was 1.108. However, where the duration of the program was long, the mean **Effect Size** was 1.958. Long durations, in general, were associated with higher **Effect Sizes** (a mean of 1.475).

Showing Breakdowns for Other Groups

From the results screen, you can quickly flip through breakdowns for other groups in your meta-analysis. Press ↑ or ↓ to select a new column variable. Press → or ← to select a new row variable.

8 Charting Data

Meta-Stat offers a variety of powerful charting features to help you explore—and present—your data.

Before You Begin

Read the section "Common Functions" at the beginning of Chapter 7. That section describes common ***Meta-Stat*** functions that apply to statistical analyses, which are covered in Chapter 7, as well as to charts, which are the subject of this chapter. In particular, you should know how to:

- Select variables to be analyzed and charted.
- Deselect variables that are already selected.
- **Weight** data using a weighting variable.
- Select data with **SELECT IF** statements.

Setting Chart Options

Before creating charts, you can change the ***Meta-Stat*** chart options.

Video Mode

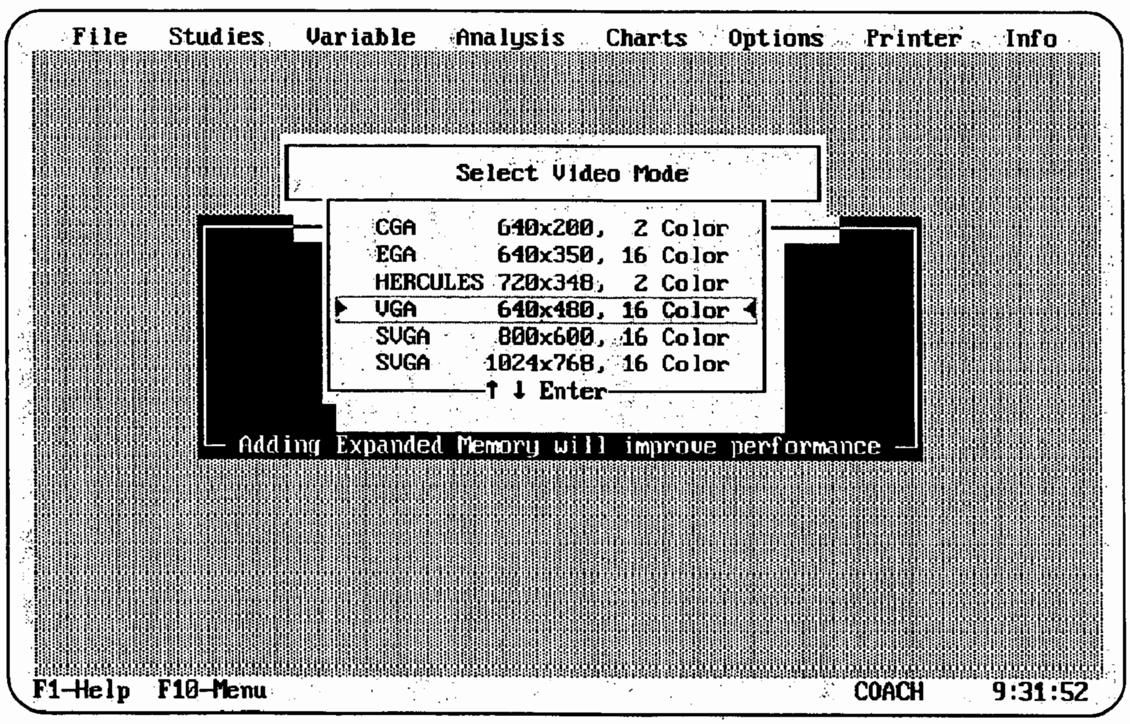
Meta-Stat can display charts in a variety of video modes. Select a mode that is compatible with your display adapter.

NOTE: When you save a chart by pressing **Ctrl-S**, ***Meta-Stat*** saves the chart in VGA resolution (640 x 480), regardless of the video mode you are currently using.

Follow these steps to set the video mode:

1. Select **Charts/Video Modes**

   Meta-Stat displays a list of modes you can use:



2. Highlight the mode you want to use, then press **Enter**.

PCX Colors and Size

When you save a chart by pressing **Ctrl-S**, ***Meta-Stat*** saves the chart as a PCX-formatted file. You can then import this file into other applications, or view it later from within ***Meta-Stat***. ***Meta-Stat*** can save the chart in color or in black and white. Typically, you would use color if you wanted to produce color slides, and black and white if you wanted to reproduce charts for a published article.

You can also specify the size of your charts on printed output.

Follow these steps:

1. Select **Charts/PCX Colors**
2. Highlight **Black & White** or **Color**, then press **Enter**.
3. Select **Charts/Graph Size**
4. Specify the height and width you want to use, then press **Enter**.

Point and Shoot Resolution

When you create a scatterplot, you can display the study data for a particular data point. You do this by using your mouse to "point and shoot" at the data point.

You can set the point and shoot resolution so that your mouse points at different-sized areas. By setting a wide resolution, for example, you can select many data points at once—even data points that are not directly below the mouse pointer. With a narrow resolution, you must move the mouse pointer directly to a data point before you can select it.

NOTE: ***Meta-Stat*** displays a mouse pointer only if you create the scatter chart when in **CGA, VGA**, or **Hercules** video mode. You do not see the pointer when you use either of the two **Super VGA (SVGA)** modes.

Follow these steps to select the point and shoot resolution:

1. Select **Charts/P&S Resolution**.
2. On the screen that ***Meta-Stat*** displays, type a number from 1 to 10, then press **Enter**.

   Larger numbers provide wider resolution. Smaller numbers provide more narrow resolution.

Saving Charts

After you create and display a chart, you can save it by pressing **Ctrl-S**. ***Meta-Stat*** saves the chart in a PCX-formatted file. You can then import this file into another application, or you can view it later with ***Meta-Stat***.

Meta-Stat saves the PCX file in the ***Meta-Stat*** directory. It selects the filename for you:

- The filename extension is PCX.
- The beginning of the name identifies the type of chart—**BAR** for a Bar chart, **BOOT** for a Bootstrap chart, **LINE** for a Line plot, and so on.
- A number identifies the file uniquely. For example, BAR0.PCX is the first Bar chart you created, BAR1.PCX is the second, and so on. ***Meta-Stat*** selects this number for you, based on the charts you have already saved.

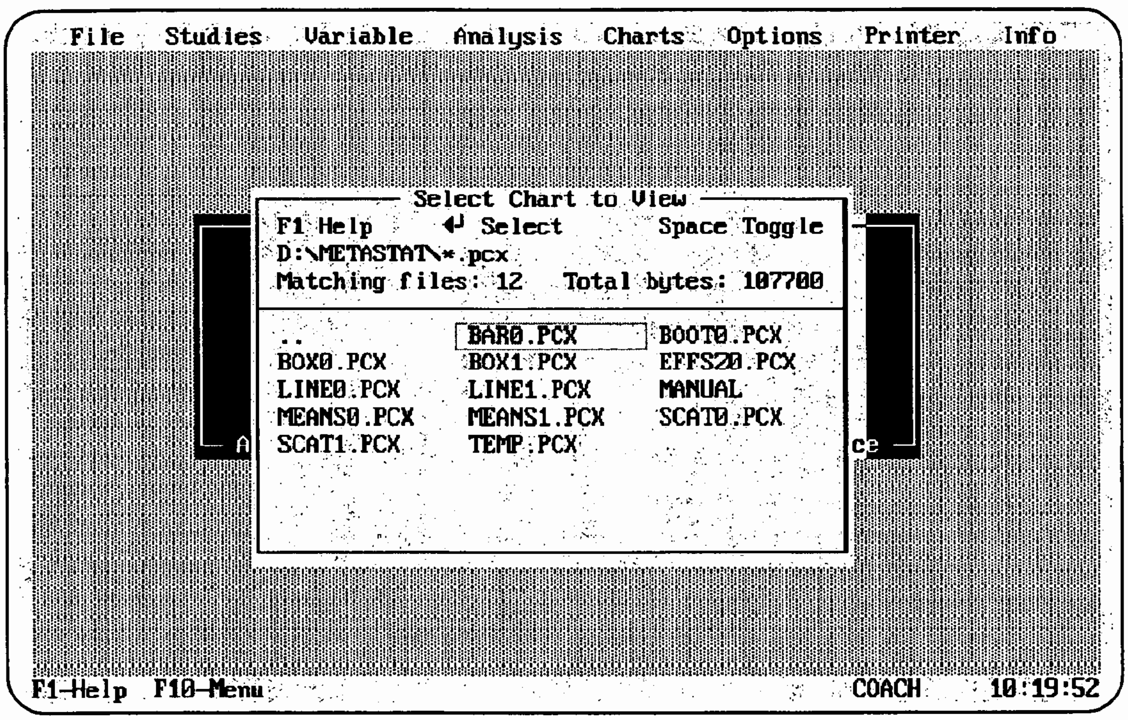
Viewing and Deleting Charts

After you save charts, you can view them from within ***Meta-Stat***. You can also delete them if you no longer need them.

Viewing a Saved Chart

1. Select **Charts/View Saved Chart**

   Meta-Stat displays a list of charts that you have saved:



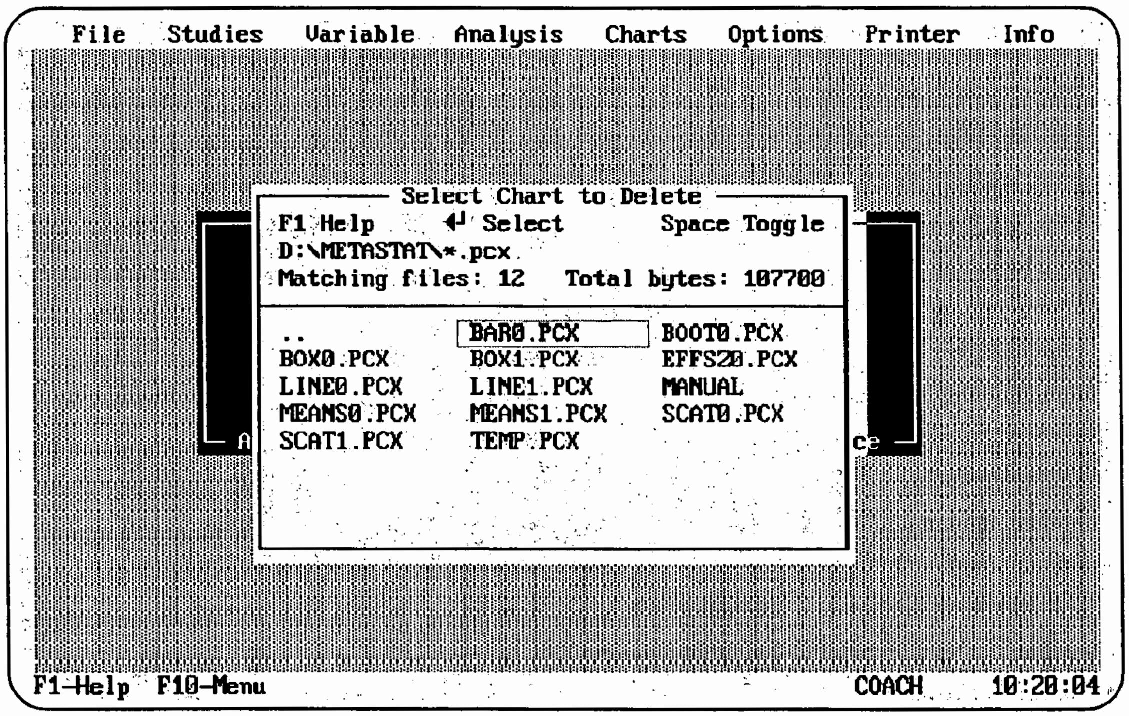
2. Highlight the name of the PCX file that you want to view, then press **Enter**.

NOTE: ***Meta-Stat*** saves charts in **VGA** resolution (640 x 480). For best results, switch to **VGA** resolution before viewing a chart. If you view a saved chart while using a different resolution, the chart will be either smaller or larger than your screen.

Deleting a Saved Chart

1. Select **Charts/Delete Saved Chart**

   Meta-Stat displays a list of charts that you have saved:



2. Highlight the name of the PCX file that you want to delete, then press **Enter**.
3. ***Meta-Stat*** asks you to confirm (**Y** or **N**).

Creating a Bar Chart (Frequency Analysis)

Meta-Stat's Bar chart can display the frequency with which values occur for a variable. Follow these steps to create a Bar chart:

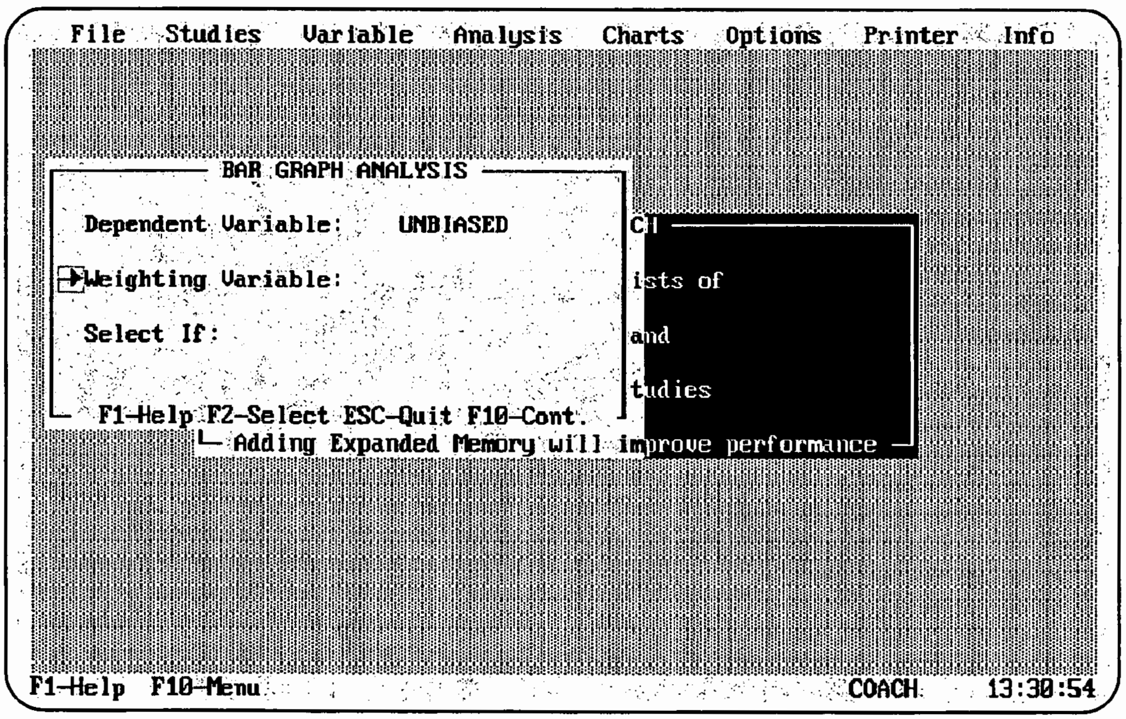
1. Select **Charts/Bar (freq)**.

   Meta-Stat displays a screen where you select the variable you want to chart.

2. Use **Criterion Variable** to identify the variable you want to chart.

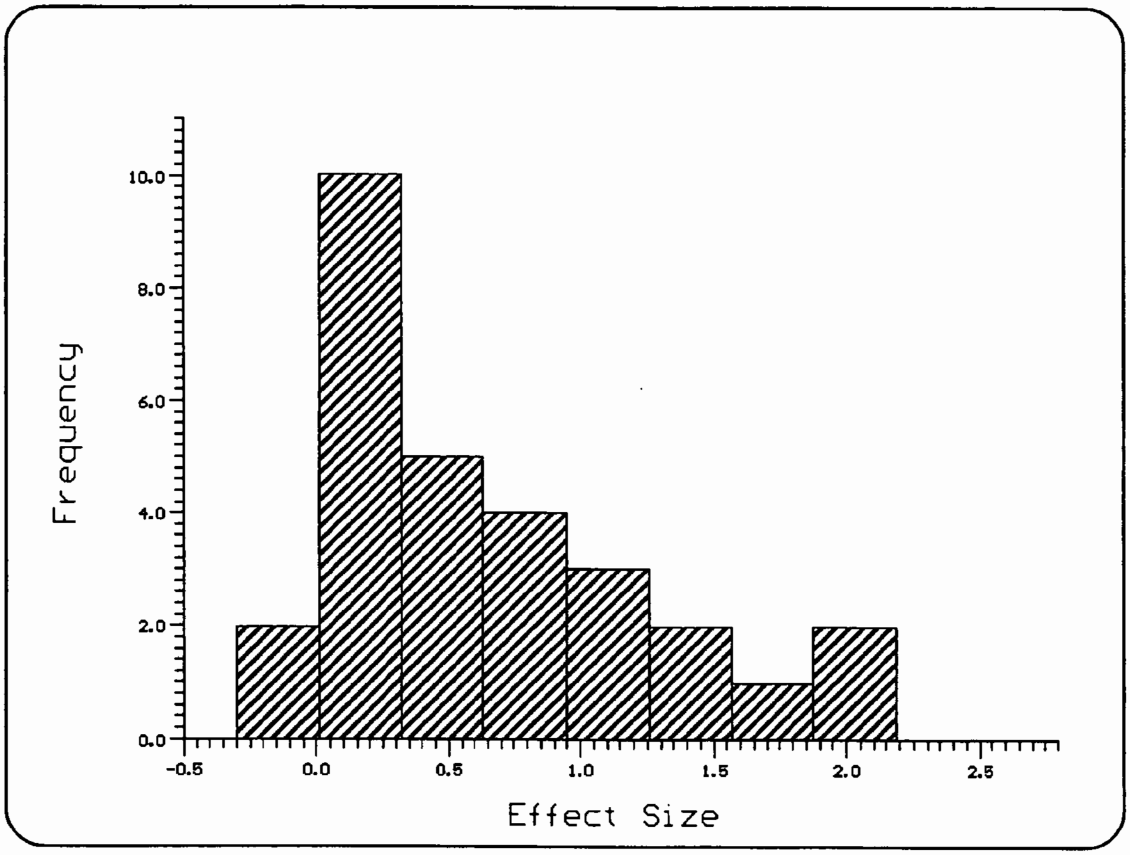
3. If necessary, identify a weighting variable and construct a **SELECT IF** statement. *For more information, see "Common Functions" at the beginning of Chapter 7.*

   In the following example, ***Meta-Stat*** will chart the **Unbiased Effect Size**:



4. Press **F10** to display the results.

   Notice that ***Meta-Stat*** aggregates the values of the variable and selects an appropriate scale for the **X** axis:



5. Press ↓ to select and chart a new variable.

Creating a Bootstrap Chart

To create the Bootstrap chart, ***Meta-Stat*** uses a brute-force resampling technique to calculate expected effect sizes for the population of studies in your meta-analysis. For up to 1,000 iterations, ***Meta-Stat*** randomly selects an **Effect Size** from your population of studies, then records the frequency at which each **Effect Size** is picked.

Follow these steps to create the chart:

1. Select **Charts/Bootstrap**.

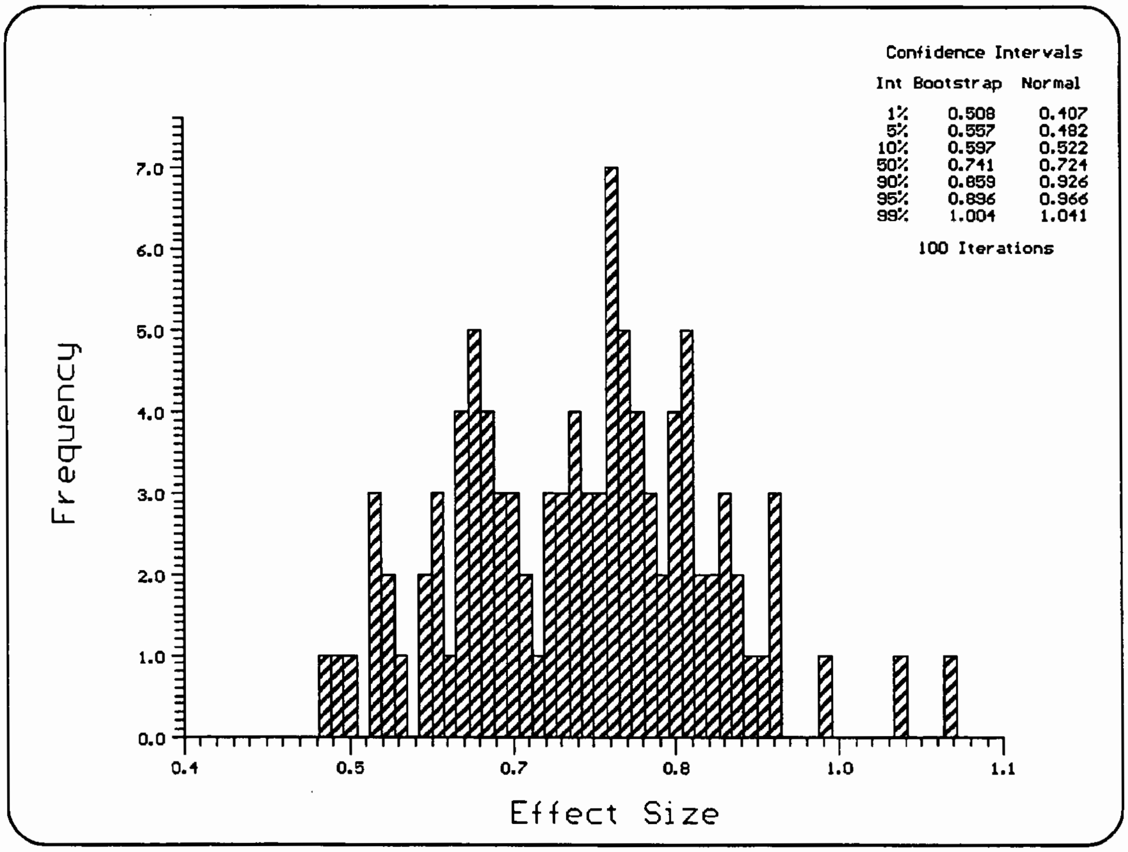
   Meta-Stat displays a screen where you select the variable you want to chart.

2. Use **Criterion Variable** to identify the **Effect Size** variable.

3. If necessary, identify a weighting variable and construct a **SELECT IF** statement. *For more information, see "Common Functions" at the beginning of Chapter 7.*

4. Press **F10** to display the chart.

   In the following example, 100 iterations were used. Notice the tallest bar on the chart. This bar indicates that, of the 100 picks, the **Effect Size** 0.75 was picked 7 times.



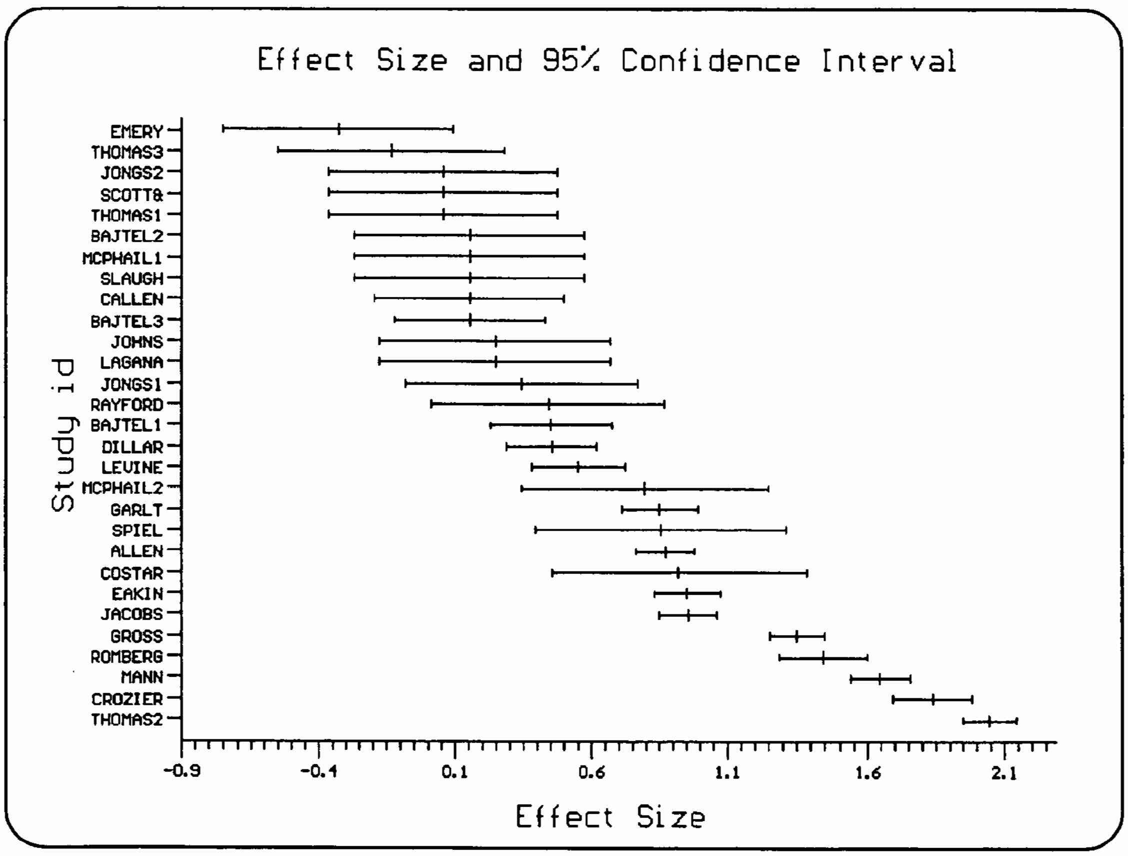
NOTE: The bootstrap procedure assumes the data were randomly selected.

Charting Effect Sizes by Study

Use the **Effect Size** by Study chart to plot the **Effect Size** and 95% confidence intervals for the mean of the studies in your meta-analysis. Follow these steps:

1. Select **Charts/Effect Size by Study**.
2. Use the **Sort Data** field to specify a sorting sequence for the chart.

   You cannot specify a different criterion variable. The **Effect Size** variable is always used.
3. Press **F10** to display the results. In the following example, effect sizes are sorted by value, in descending order:



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Showing Relationships on a Line Graph

Use a Line graph to show the relationship between an predictor variable and the criterion variable, **Effect Size**. You can use discrete and blocking variables to group data into separate plots on the same chart.

1. Select **Charts/LineGraph**.

   Meta-Stat displays a screen where you identify the variables and other information for the chart.

2. Use the **Criterion (y) Variable** field to specify the variable you want to plot on the Y axis of the chart. Typically, this is the **Effect Size**.

   Use **Transform y** to apply various transformations to this variable. You can also smooth the results with **Smooth y.**

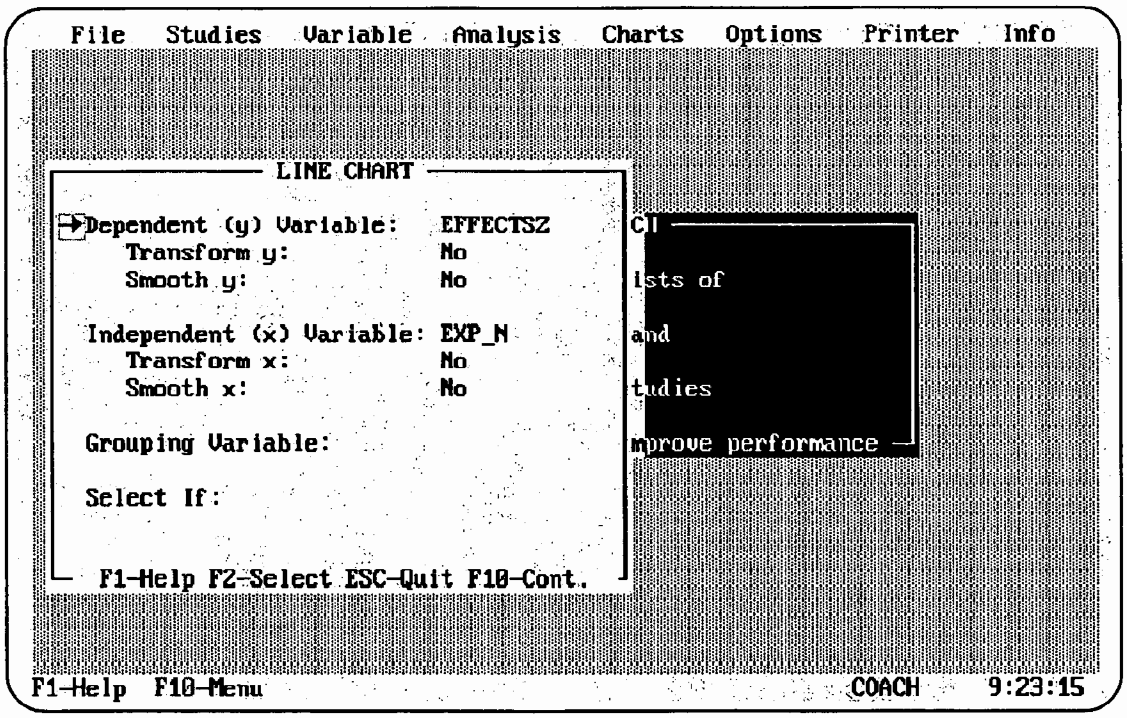
3. Use the **Predictor (x) Variable** field to specify the variable you want to plot on the **X** axis of the chart.

   Use **Transform x** and **Smooth x** to transform and smooth the variable.

4. Optionally, use the **Grouping Variable** field to identify a discrete or blocking variable. ***Meta-Stat*** will separately plot each category within the variable.

5. If necessary, use **SELECT IF** to select data for the chart.

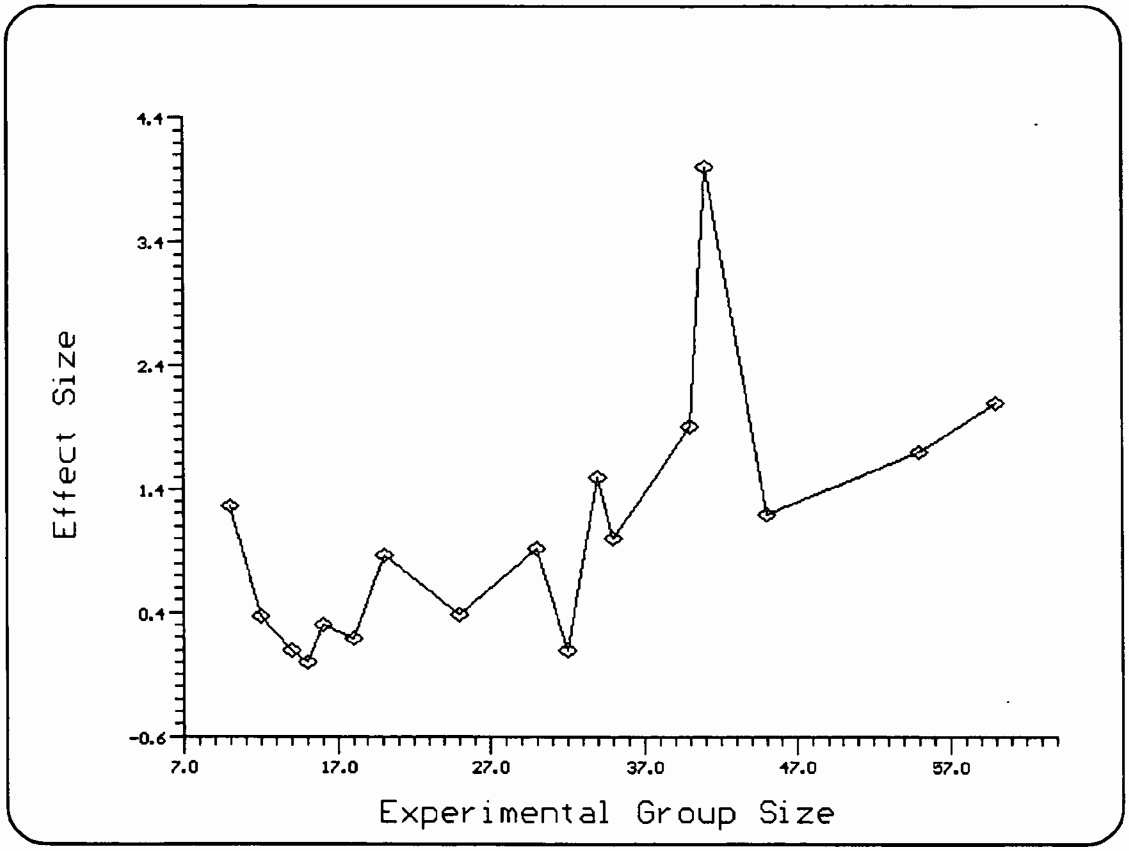
   In the following example, ***Meta-Stat*** will chart the relationship between **EFFECTSZ** (**Effect Size**) and **EXP_N** (the size of the experimental group):



6. Press **F10** to display the results.

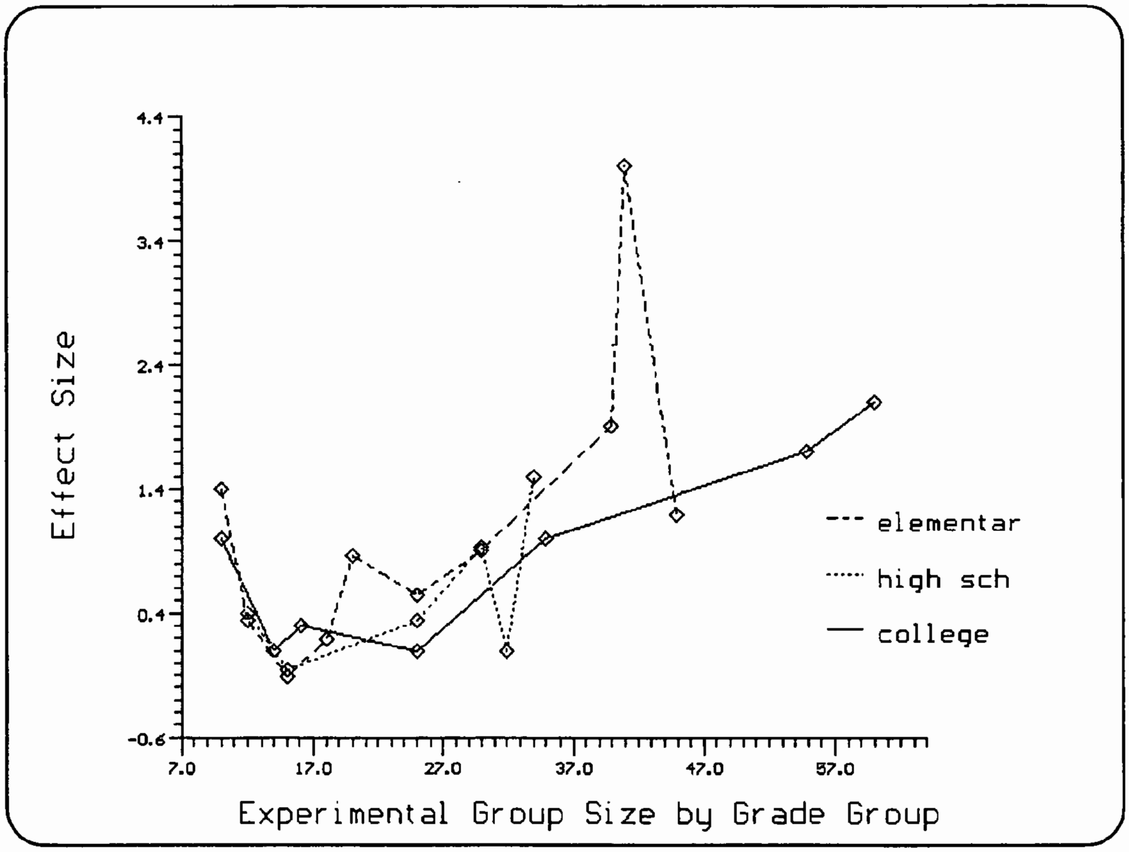
Results for X and Y Variables

If you specified only an **X** and **Y** variable, ***Meta-Stat*** shows a single plot:



Results with a Grouping Variable

If you specified a grouping variable in addition to **X** and **Y** variables, ***Meta-Stat*** shows one plot for each category identified by the grouping variable. For the following example, a blocking variable called **Grade Group** was specified. This variable identifies three groups of subjects: elementary, high school, and college subjects.



Selecting Other Variables

Once you have displayed the chart, you can quickly select other variables for the chart:

Press this key	To select a new ...
↑ or ↓	Criterion (Y) variable
→ or ←	Predictor (X) variable
space or **backspace**	Grouping variable

NOTE: To look up the data behind a data point, plot the same variables on a scatterplot. Then "point and shoot" with your mouse on the data point.

When multiple values of the criterion variable have the same value on the predictor variable, ***Meta-Stat*** plots their average. It is good practice to examine the Scatterplot of the same data.

Plotting Data Points on a Scatter Plot

Use a Scatter plot to plot individual data points that show the relationship between a predictor variable and the criterion variable, typically **Effect Size**. After you display the chart, you can use your mouse to display study data by "pointing and shooting" at a data point.

1. Select **Charts/Scatter Plot**.

   Meta-Stat displays a screen where you identify the variables and other information for the chart.

2. Use the **Criterion (y) Variable** field to specify the variable you want to plot on the Y axis of the chart. Typically, this is the **Effect Size**.

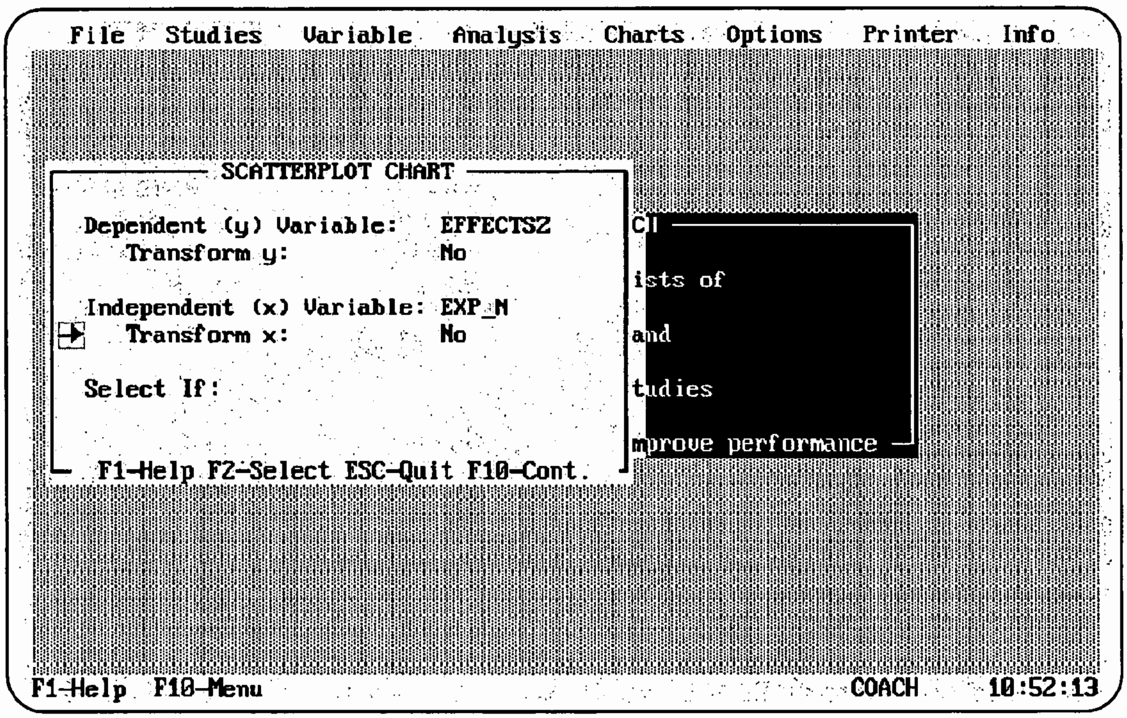
   Use **Transform y** to apply various transformations to this variable.

3. Use the **Predictor (x) Variable** field to specify the variable you want to plot on the X axis of the chart.

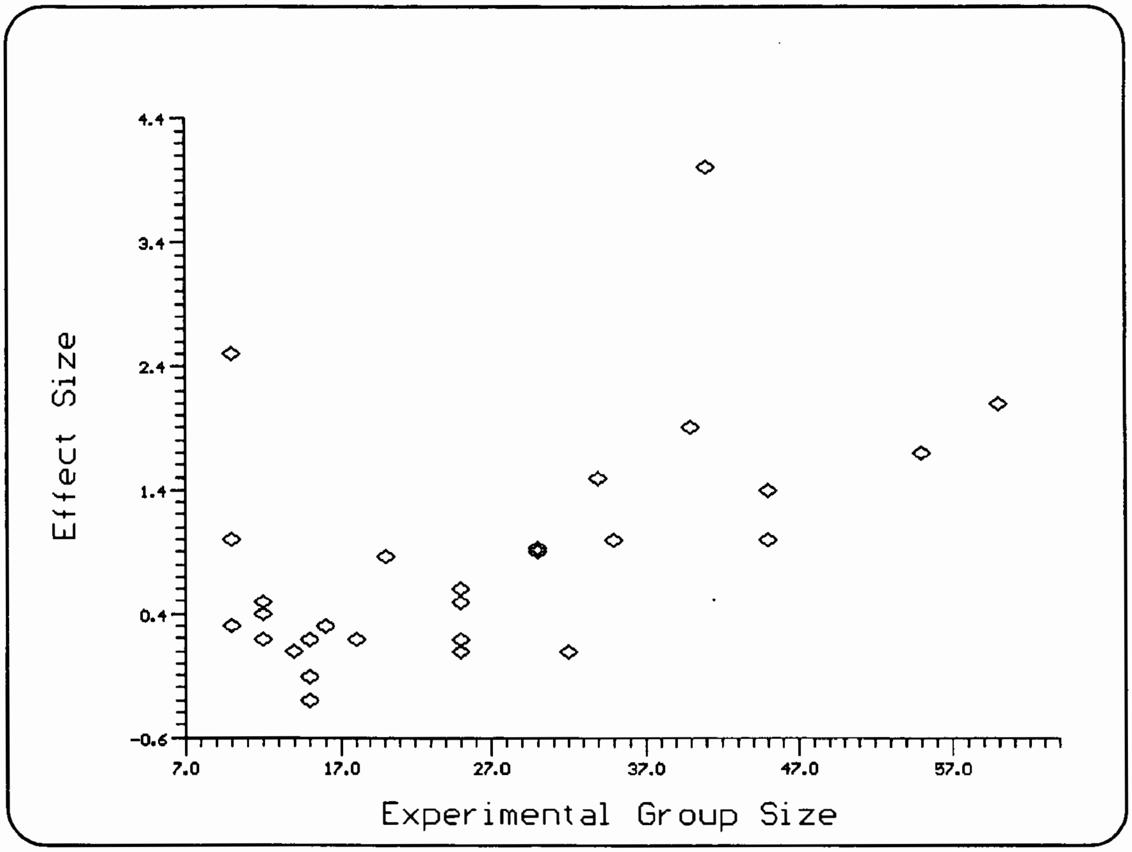
   Use **Transform x** to transform the variable.

4. If necessary, use **SELECT IF** to select data for the chart.

   In the following example, ***Meta-Stat*** will create a scatter plot showing the relationship between **EFFECTSZ** (**Effect Size**) and **EXP_N** (the size of the experimental group):



5. Press **F10** to display the results:



Selecting Other Variables

Once you have displayed the chart, you can quickly select other variables for the chart by pressing ↑ ↓ → or ←.

Pointing and Shooting at Data Points

If you create a Scatterplot while in **CGA, VGA**, or **Hercules** video mode, you can move the pointer—shown as a magnifying glass—to a data point and left-click. ***Meta-Stat*** displays the study (or studies) represented by the data point.

If the magnifying glass was pointing at more than one data point, ***Meta-Stat*** displays the study for the first data point. Press **F8** to display additional studies.

Showing the Median, Range, and Quartiles with Box & Whiskers

Use the **Box & Whiskers** chart to display the median, range of values, and percentiles for a variable. You can also use discrete and blocking variables to group data into separate **Box & Whiskers** on the same chart.

To create the **Box & Whiskers** chart, follow these steps:

1. Select **Charts/Box & Whiskers.**

   Meta-Stat displays a screen where you identify the variables and other information for the chart.

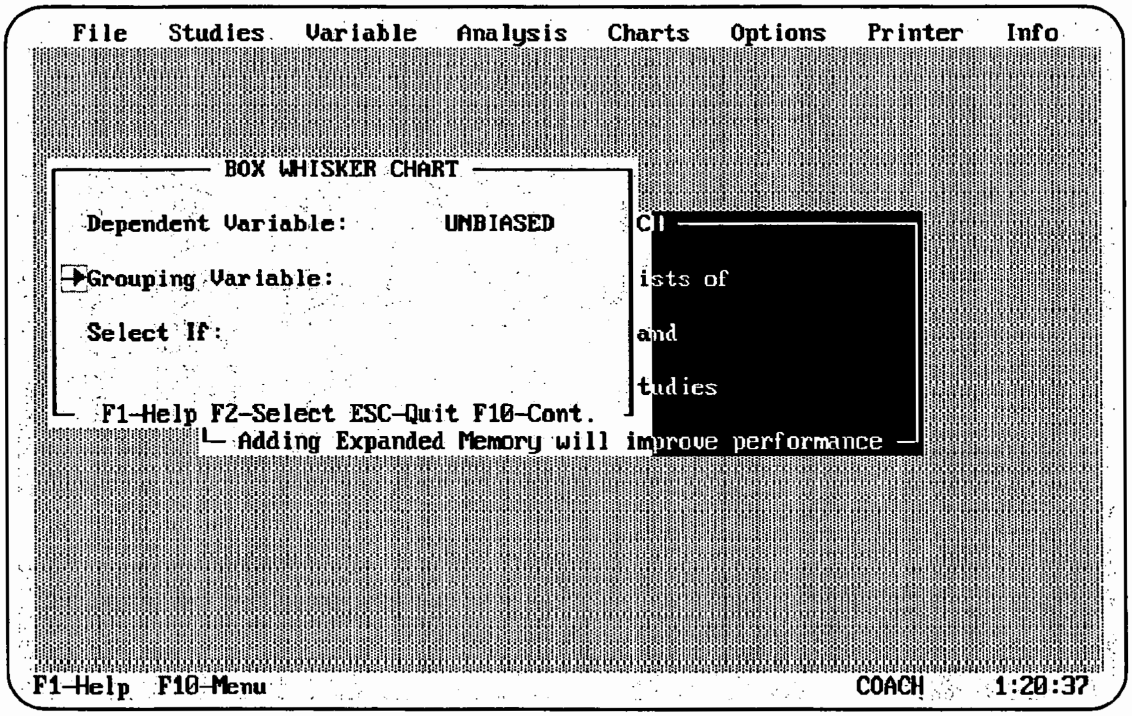
2. Use the **Criterion Variable** field to specify the variable you want to measure.

3. Optionally, use the **Grouping Variable** field to identify a discrete or blocking variable. *Meta-Stat* will create a separate graphic for each category within the variable.

4. If necessary, use **Select If** to select data for the chart.

   In the following example, *Meta-Stat* will measure the unbiased effect size:

In the following example, ***Meta-Stat*** will measure the unbiased effect size:

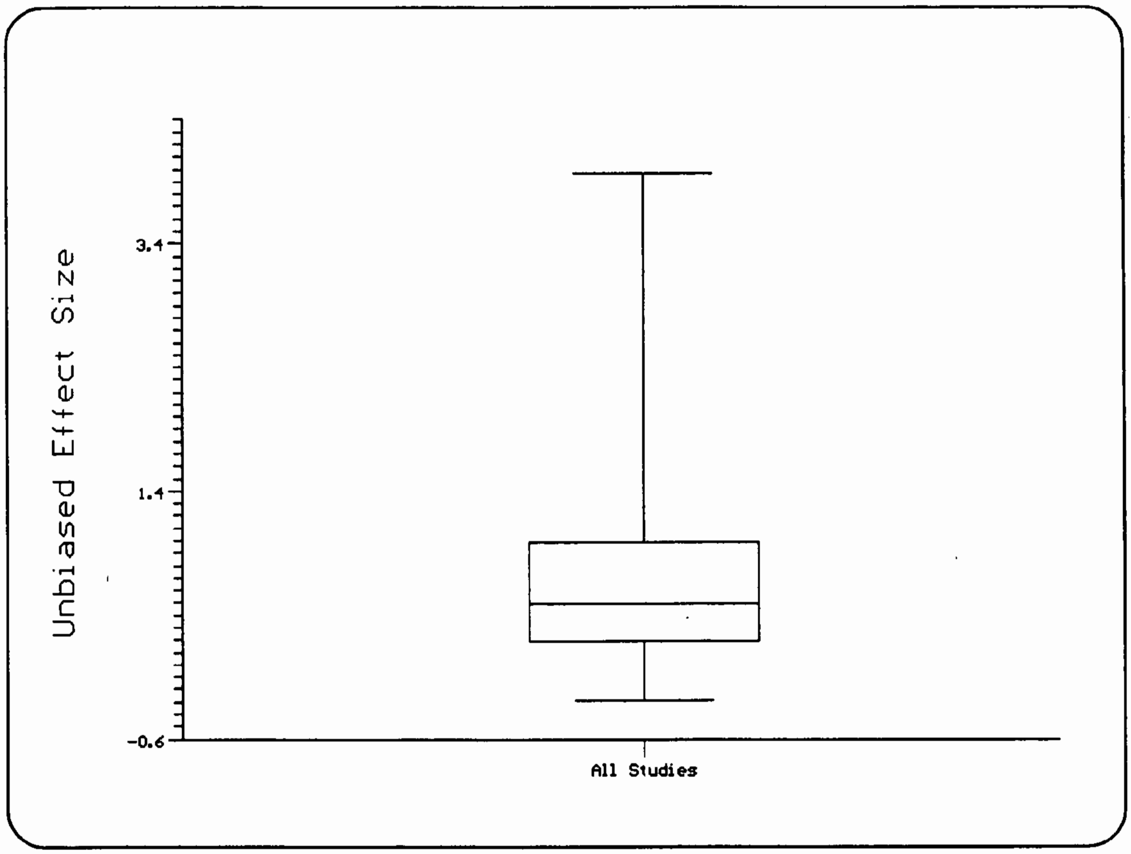


5. Press **F10** to display the results. The results are displayed as follows:

Graphic Feature	**Description**
Top of Whisker	The maximum value
Bottom of Whisker	The minimum value
Top of Box	The 75th percentile, the third quartile
Bottom of Box	The 25th percentile, the first quartile
Line inside the Box	The 50th percentile, the median

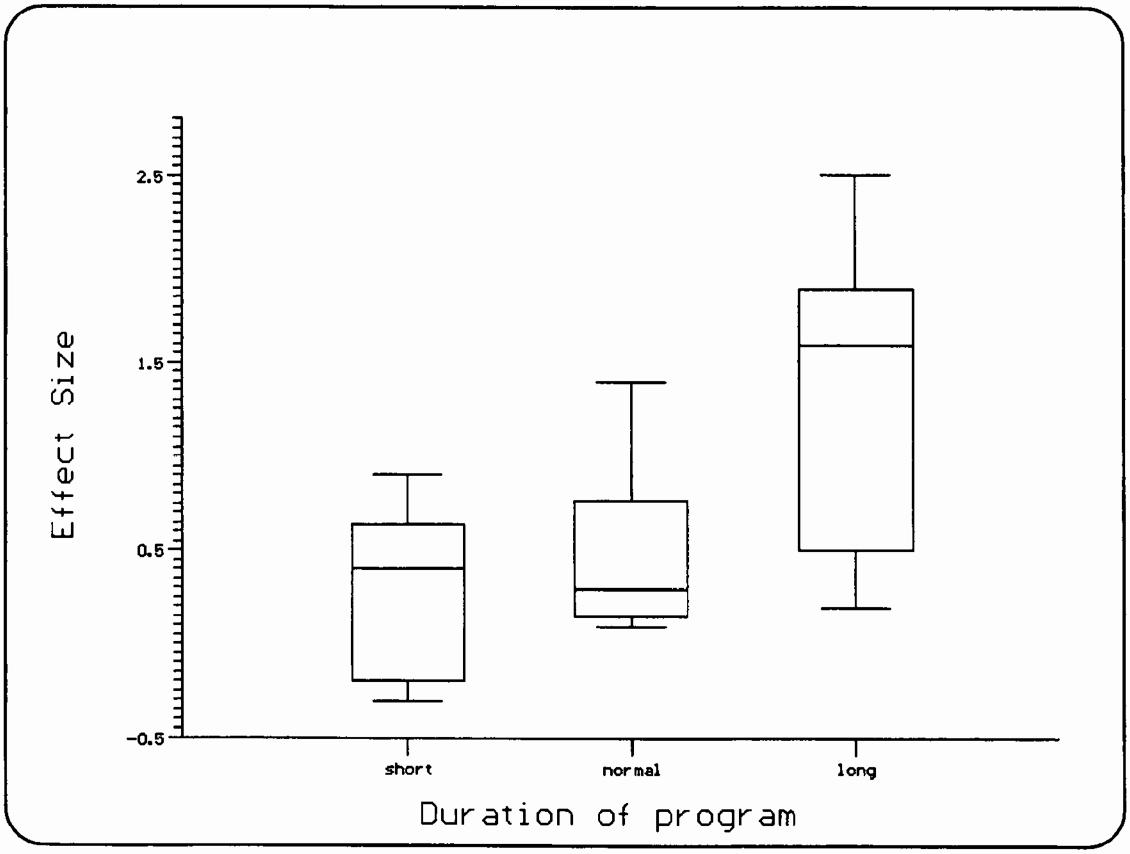
Results for a Criterion Variable

If you specified only a criterion variable, ***Meta-Stat*** shows a single **Box & Whiskers**:



Results with a Grouping Variable

If you specified a grouping variable in addition to the criterion variable, ***Meta-Stat*** shows a separate graphic for each category identified by the grouping variable. For the following example, a grouping variable called **Hour Group** was specified. This variable identifies the duration of the intervention program:



Selecting Other Variables

Once you have displayed the chart, you can quickly select other variables for the chart:

Press this key	To select a new ...
↑ or ↓	Criterion variable
space or **backspace**	Grouping variable

Displaying the Mean Values for Groups

Use the Means chart to show the mean value for one or more groups, as are represented by discrete or blocking variables. ***Meta-Stat*** measures the value for each group. The chart also shows the 95% confidence interval.

To create the Means chart, follow these steps:

1. Select **Charts/Means.**

   Meta-Stat displays a screen where you identify the variables and other information for the chart.

2. Use the **Criterion Variable** field to specify the variable you want to measure.

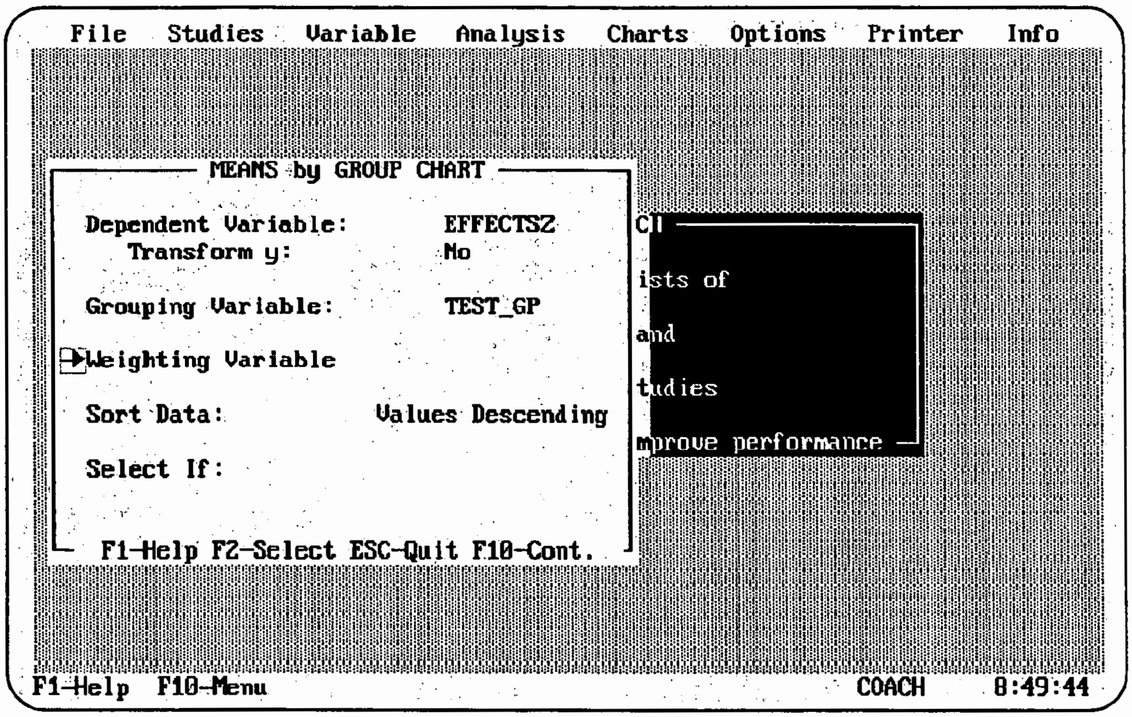
   Use **Transform y** to apply various transformations to this variable.

3. Optionally, use the **Grouping Variable** field to specify a discrete or blocking variable. ***Meta-Stat*** will show the means only for the groups identified by this variable.

   If you leave this field blank, ***Meta-Stat*** will show the means for *all* discrete and grouping variables.

4. You can weight, sort, and select data for the chart, if necessary.

In the following example, ***Meta-Stat*** will show the mean effect sizes for a variable called **TEST_GP**:



5. Press **F10** to display the result.

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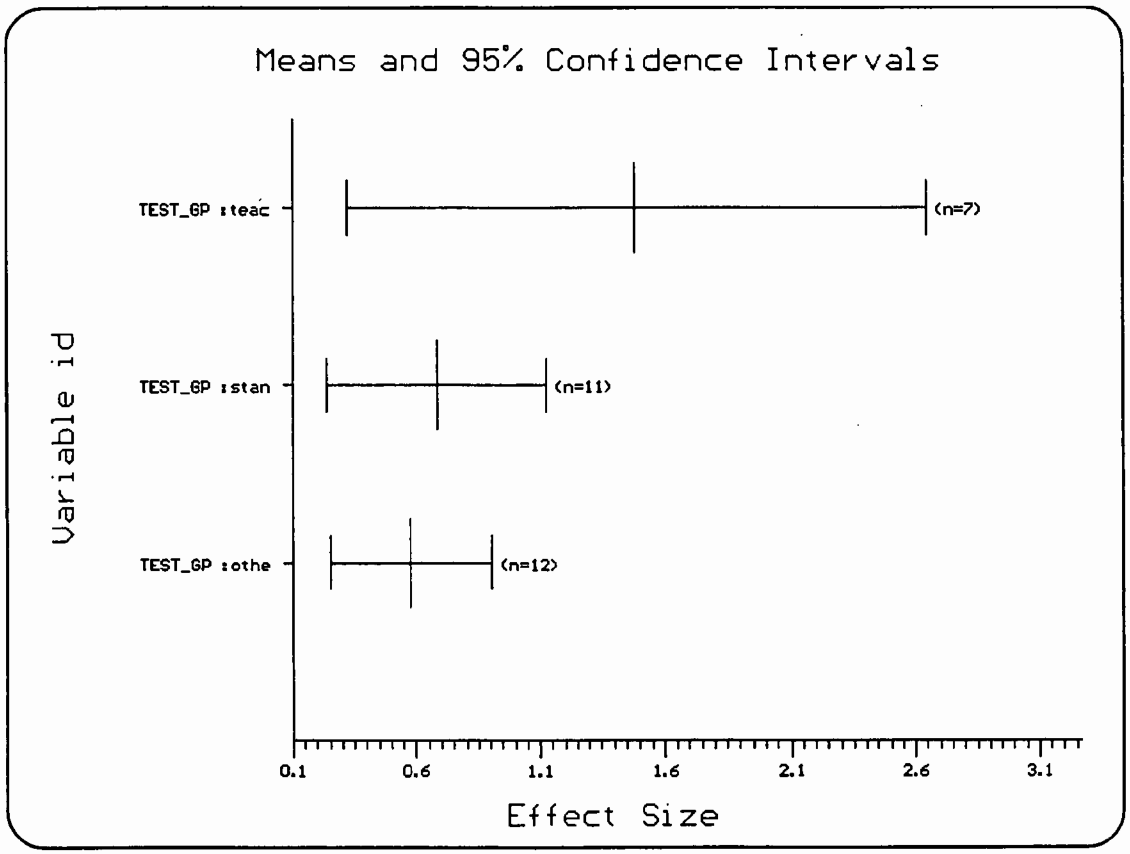
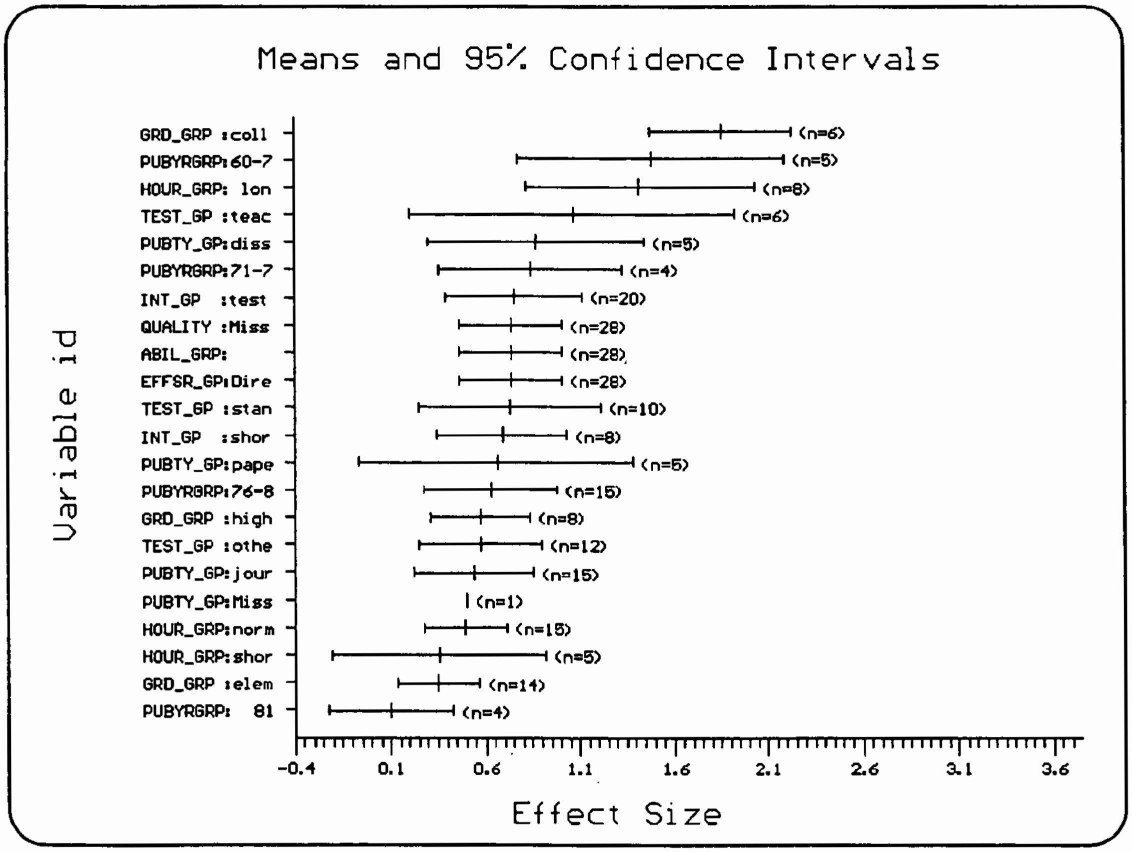
Results for a Single Grouping Variable

If you specified a grouping variable, ***Meta-Stat*** shows the means for categories within that group:



Results with a Grouping Variable

If you did not specify a grouping variable, ***Meta-Stat*** shows the means for all categories within all groups. In the following example, the data are sorted by value, in descending order:



Selecting Other Variables

Once you have displayed the chart, you can quickly select other variables for the chart:

Press this key	To select a new ...
↑ or ↓	Criterion variable
space or **backspace**	Grouping variable

9 Technical Information

This chapter outlines various equations and procedures used in ***Meta-Stat***. The equations are based on generally accepted statistical principles and on methods described in Glass, McGaw, and Smith (1981), Hunter and Schmidt (1990), Cohen (1977), Veldman (1967), Hedges and Olkin (1985), Draper and Smith (1966), and SPSS (1991). The reader is referred to these excellent materials for a fuller development of the technical approaches used in ***Meta-Stat***.

Conversion Formulas

Meta-analysis is based on placing the results from different research studies on a common metric. ***Meta-Stat*** allows the user to use either **Effect Size** or correlation as that common metric. To calculate **Effect Size** from a ***t, F,*** χ^2**,** or ***p-value***, the reported statistics are first converted to a correlation (***r***) and the correlation is converted to an **Effect Size** (***d***). Taylor and White (1993) found that the alternative methods for computing **Effect Size** yield very comparable results.

The following formula is used to convert from an ***r*** to **Effect Size**:

$$d = \sqrt{\frac{4r^2}{1-r^2}}$$

Correlational meta-analysis simply uses the ***r*** as the common metric.

- To derive $\boldsymbol{r}$ from a t-statistic:

$$r = \sqrt{\frac{t^2/(1-r_{xy})^2}{t^2/(1-r_{xy})^2 + df}}$$

- To derive $\boldsymbol{r}$ from an F-statistic:

$$r = \sqrt{\frac{F}{F + df}}$$

Here *df* refers to the denominator degrees of freedom. The equation is only appropriate when there is 1 degree of freedom in the numerator.

- To derive $\boldsymbol{r}$ from a χ^2-statistic with 1 degree of freedom:

$$r = \sqrt{\chi^2/N}$$

- To derive $\boldsymbol{r}$ from a probability level ($\boldsymbol{p}$), $\boldsymbol{p}$ is first converted to a z and the z is then converted to an $\boldsymbol{r}$:

$$z = a - \frac{2.515517 + .802853a + .010328a^2}{1 + 1.432788a + .189269a^2 + .001308a^3}$$

where

$$a = \sqrt{\ln (1 / p^2)}$$

$$r = \sqrt{z^2 / N}$$

- To compute **Effect Size** as the standardized mean difference:

$$d = \frac{\bar{x}_e - \bar{x}_c}{\sigma_c \sqrt{1 - r_{ec}^2}}$$

- To compute **Effect Size** as parametric gain scores:

$$d = \frac{\bar{x}_{e,post} - \bar{x}_{e,pre}}{\sigma_{e,pre}} - \frac{\bar{x}_{c,post} - \bar{x}_{c,pre}}{\sigma_{c,pre}}$$

- To compute **Effect Size** from a paired comparison t-test

$$d = \bar{D} \frac{\sqrt{N}}{t}$$

where $\bar{D}$ is the mean difference between the observed pairs.

This last equation is from Gibbons, Hedeker, and Davis (1993).

Pre-Coded Variables

There are precoded equations in both the **Effect Size** and correlational meta-analysis modules. Here, we discuss these equations and outline their use.

Effect Size Meta-Analysis

Two pre-coded variables are used in the **Effect Size** meta-analysis module, **UNBIASED**, and **WEIGHT**. Both of these variables are based on the work of Hedges and Olkin (1985).

The **Unbiased Effect Size,** d', is used in several homogeneity calculations and as the bases for the **Effect Size** plot. It should be noted that d' usually differs only slightly from d, especially as N gets large (see Hedges and Olkin, 1985, pp 78-79.). Taylor and White (1993) found that d' and d produce the same conclusions.

$$d' = d\left(1 - \frac{3}{4N_t - 9}\right)$$

where N_t is the total sample size and d is the original effect-size.

The variable **WEIGHT** is the inverse of the variance. The variance is used in the **Effect Size** plot. The optimal weight when analyzing d' and estimating the true **Effect Size** is the inverse of the variance. The most precise studies are given the greatest weight. The more precise studies are give higher weights (see Hedges and Olkin, 1985, pp 302-304).

$$WEIGHT = \frac{2N_t N_e N_c}{2N_t^2 + N_e N_c (d')^2}$$

Correlational Meta-Analysis

The correlational meta-analysis modules have numerous precoded variables, including adjusted correlation, weights, and attenuation formulas.

Adjusted Correlation and Weights

The adjusted correlation is the unadjusted correlation divided by the product of the correction factors. This is the what the correlation would be if it were not for artifacts in the data.

Two suggested weights are provided based on discussions by Hunter and Schmidt (1990, pages 145-150). **WEIGHTB** is the optimal weight presented by Hedges and Olkin (1985):

$$W_b = CF^2 \frac{N_t - 1}{(1 - r^2)^2}$$

CF, the product of the correction factors (attenuation factors to use the terminology of Hunter and Schmidt), is discussed in the next section.

In the case of multiple independent variables, W_b is multiplied by

$$1 + r^2 + \left(\frac{\sigma}{\sigma_{ref}} - 1\right)$$

Hunter and Schmidt show that **WEIGHTA** = $N_t\, CF^2$ can differ only trivially from **WEIGHTB** and has the desired effect -- the greater the correction needed for a study, the less weight it is given. As with the **Effect Size** weight above, you may want to use one of these weights to obtain an improved true value estimate of the corrected (adjusted) correlation.

Attenuation Formulas

Attenuation formulas are used in correlational meta-analysis to adjust for characteristics of the data (***artifacts*** to use the terminology of Hunter and Schmidt). They provide a theoretical estimate of the attenuation in the true correlation due to data characteristics.

If r_o is the observed correlation, p is the true correlation, and CF is a correction factor for some data characteristic, then $p = r_o/CF$. Correction factors can be computed for multiple data characteristics and are assumed to be independent.

- To correct for unreliability in either the dependent or independent variable:

$$CF = \sqrt{r_{xx}}$$

where r_{xx} is the reliability of the measure used to assess the dependent or independent variable.

- To correct for variable dichotomization (i.e., to assess the correlation for a continuous variable given a point biserial correlation):

$$CF = \frac{\phi(c)}{\sqrt{P(1-P)}}$$

where c is the point in the normal distribution that divides the distribution into proportions P and $1\text{-}P$, i.e., the inverse of the cdf (values for c are derived using a look-up table), and

$$\phi(c) = \frac{e^{-\frac{1}{2}c^2}}{\sqrt{2\pi}}$$

i.e., the normal ordinate at c.

- To correct for the use of a proxy dependent or independent variable:

$$CF = r_{xy} \sqrt{r_{xx}}$$

where r_{xy} is the correlation of the proxy variable with the variable it is replacing and r_{xx} is the reliability of the proxy variable.

- To unpartial a partial correlation:

$$CF = 1 / \sqrt{1 - r_{zy}^2}$$

where r_{zy} is the correlation of the extraneous variable with the dependent variable.

- To correct for restriction in range for the independent variable:

$$CF = \sqrt{u^2 + r_o^2(1 - u^2)}$$

where u is the ratio of the study standard deviation to the referencestandard deviation.

Probability

Probabilities for various statistics are based on Kendall's (1955) normalizing transformation of the F distribution:

$$z = \frac{\left(1 - \frac{2}{9B}\right) F^{1/3} - \left(1 - \frac{2}{9A}\right)}{\sqrt{\frac{2}{9B} F^{2/3} + \frac{2}{9A}}}$$

where A is the df for the numerator of the F ratio, and B is the df for the denominator.

If B<4 then Z is transformed using Kelley's (1947) correction

$$z' = z + \frac{.08z^5}{B^3}$$

The z or z' then provides the basis for approximating the ***p-level*** using:

$$p = .5/(1+.196854z+.115194z^2+.000344z^3+.019527z^4)^4$$

The procedure is used to provide the exact probability of other statistics:

z Since $F_{1,\infty} = z^2 = t_\infty^2$, the probability for a z is computed using $A=1$, $B=1000$, $F=z^2$.

χ^2 Since $F = \chi^2/df$ with (df,∞) degrees of freedom, the probability for a chi-square statistic is computed using $A=df$, $B=1000$, $F=\chi^2/df$.

t Since $F = t^2$ with (1,df) degrees of freedom, the probability for a t-statistic is computed using $A=1$, $B=df$, $F=t^2$.

Statistical Analyses

The following identifies the equations used in the analysis module of ***Meta-Stat***

Descriptive Statistics

This procedure provided the weighted and unweighted mean, median, variance, standard deviation, minimum value, maximum value, and range given a specified variable and an optional weighting variable.

The computational formula used to derive the mean and variance are:

$$Mean = \sum (x_i w_i) \;/ \sum w_i$$

where x_i is dependent variable data and w_i is the weight for observation i (w_i is set equal to 1 for all i if a weighting variable is not specified)

$$\sigma^2 = \frac{\sum w_i (x_i)^2}{\sum w_i} - \left(\frac{\sum x_i w_i}{\sum w_i} \right)^2$$

The standard deviation is simply the positive square root of the variance. This is the standard deviation of the presented data. To treat this data as a sample and to obtain an unbiased estimate of the population variance, you can multiply the sample variance by ***n/(n-1)***.

If the dependent variable is the unbiased **Effect Size** then a variety of additional statistics are available. Hedges's Q_T can be used to test the homogeneity of the adjusted effect sizes.

$$Q_T = \sum \frac{(d' - \overline{d'})^2}{\sigma^2_{d'}}$$

where $\sigma^2_{d'}$ is the variance of d' and is computed as the inverse of **WEIGHT**.

The computational formula used by ***Meta-Stat*** is

$$Q_T = \sum \frac{d'^2}{\sigma^2_{d'}} - \frac{\left(\sum \frac{d'}{\sigma^2_{d'}}\right)^2}{\sum 1/\sigma^2_{d'}}$$

If you page down after the presentation of the basic descriptive statistics for the adjusted **Effect Size**, another page of meta-analysis statistics appears.

Mean ES or mean **Effect Size** is the mathematical average described above. It is repeated on this screen for reference. To compute the Fisher's Z, each **Effect Size** is first converted to an r using the reverse of the formula above:

$$r = \frac{d}{\sqrt{4 + d^2}}$$

The r is then converted to an individual Z using

$$Z = .5 \ln\frac{1+r}{1-r}$$

Fisher's Z is then computed as the weighted average of the individual Z's. The probability test the null hypothesize of no population effect. By converting the Fisher's Z back to an **Effect Size** or an r (equivalent es and equivalent r), we have a refined estimate of the population **Effect Size** and correlation. The Failsafe N identifies the number of studies with opposite conclusions that would be needed to overturn a rejected null hypothesis.

$$\textit{Fail safe } N = \frac{N_t\,(Z^2\ -\ 3.8416)}{3.8416}$$

The variance ratio is the ratio of the **Effect Size** sampling error variance σ_e^2 to the variance of the overall mean **Effect Size**. The error variance is computed as

$$\sigma_e^2 = \left(\frac{N-1}{N-3}\right)\left(\frac{4}{N}\right)\left(1+\frac{d^2}{8}\right)$$

where N is the average sample size, and *d* is the mean effect-size. If **EFFECTSZ** rather than **UNBIASED** is the criterion variance, *d* is corrected by dividing by $1 + .75/(N-3)$.

The sampling error variance is discussed by Hunter and Schmidt (1990, page 281-338).

Regression

Meta-Stat uses the iterative stepwise multiple regression approach developed by Greenberger and Ward (1956) and described in Veldman (1967, pages 294-307). The iteration process begins by selecting the variable with the highest correlation available from the set of predictor variables. In subsequent iterations, ***Meta-Stat*** either selects the predictor variable which will maximally increase the square of the multiple correlation when added to the already selected predictor variables or adjusts the weight of one of the previously selected predictor variables. The process is terminated when neither adjustments nor the addition of variables increases the squared multiple correlation by more than .00001.

The key advantage of this iterative approach is that it allows the computation of key regression statistics (R^2 and beta weights) without having to invert the correlation matrix. Thus the non-multicolinearity restriction is not needed for computing the multiple correlation and accuracy is improved. The standard errors for the beta weights, and hence the corresponding t-statistics, however, are based on the inverted the correlation matrix. The Gauss-Jordon procedure is used to do the inverting.

Some relevant equations are:

- Adjusted R-Square:

$$\textit{Adjusted } R^2 = R^2 - \frac{(1-R^2)p}{N-p+1}$$

where N is the number of observations and p is the number of included predictor variables.

- Residual Sum of Squares:

$$SS_e = (1-R^2)(C-1)S_{yy}$$

where S_{yy} is the sample variance for the criterion variable and C is the sum of the weights.

- Regression Sum of Squares:

$$SS_R = R^2(C-1)S_{yy}$$

- Mean squares

$$MS = SS/df$$

- Standard error of the unstandardized regression weight:

$$\hat{\sigma}_{B_k} = \sqrt{\frac{aa_{kk}\,(1-R^2)\,S_{yy}^2}{S_k^2\,(N-p-1)}}$$

where aa_{kk} is the kth diagonal element of the inverted correlation matrix and S_k is the sample variance for the kth predictor variable..

- t-Statistic for testing H_o: $\beta_k = 0$

$$t_k = \frac{\beta_k \frac{S_{yy}}{S_k}}{\hat{\sigma}_{\beta_k}}$$

If the criterion variable is **UNBIASED** and the weighting variable is **WEIGHT**, then we follow the recommendations outlined on page 174 of Hedges and Olkin (1985). The weighted sum of squares about the regression is the chi-square statistic Q_E and the weighted sum of squares due to the regression Q_R. The corresponding probabilities are reported. The standard errors of the regression weights are corrected by dividing by the square root of the mean square error.

Group Means

This module provides means, standard deviations and confidence intervals by group for the selected criterion variable. Means and standard deviations are computed using the routines from the descriptive statistics discussed above. The 95% confidence intervals are computed using

$$c.i. = \overline{X} \pm t_{n-1,.05} \frac{s}{\sqrt{n}}$$

Values of *t* are obtained using a look-up table.

If the criterion variable is the **UNBIASED Effect Size**, ***Meta-Stat*** also computes Hedges's within, between and total homogeneity statistics (Hedges and Olkin, 1985, pp 153-165). The total homogeneity statistic tests whether the studies, regardless of the grouping variable, share the same **Effect Size** and is discussed above under descriptive statistics.

Hedges's between homogeneity test is analogous to the analysis of variance F-test examining whether the group means are the same. The tested hypothesis is that the group means are the same. The test statistic is:

$$Q_B = \sum_i \sum_j \frac{(d_{i.} - d_{..})^2}{\sigma^2(d_{ij})}$$

where $d_{i.}$ is the group mean weighted by the inverse of the variance, $d_{..}$ is the grand mean weighted by the inverse of the variance, and $\sigma^2(d_{ij})$ is the variance of the unbiased effect size estimator.

Q_B is tested with p groups-1 degrees of freedom.

Hedges within homogeneity test examines the hypothesis that the effect sizes are homogeneous within group. The test statistic is:

$$Q_W = \sum_i \sum_j \frac{(d_{ij} - d_{..})^2}{\sigma^2(d_{ij})}$$

Q_W is tested with N-p degrees of freedom.

Hedges and Olkin (1985, p 156) note that if the samples sizes are at least 10 per group and if the effect sizes are not too large, then the actual significance of these test statistics will be sufficiently close to the nominal values that would be obtained from a large sample distribution.

Graphical Analysis

Descriptions of the various graphs can be found in Chapter 8. The following outlines some of the equations used in the program.

Effect Size Plots

The approximate 95% confidence interval for the unbiased effect size is given by

$$d' - z_{\alpha/2}\sigma_{d'} < \delta < d' + z_{\alpha/2}\sigma_{d'}$$

where $z_{\alpha/2}$ is the two-tailed critical value of the standard normal distribution and $\sigma_{d'}$ is the positive square root of the variance of d' computed as the square root of the inverse of **WEIGHT**.

Mean Plots

The approximate 95% confidence interval about the mean is given by

$$\bar{x} - z_{\alpha/2}\sigma_{n-1} < \mu < \bar{x} + z_{\alpha/2}\sigma_{n-1}$$

where $z_{\alpha/2}$ is the two-tailed critical value of the standard normal distribution and σ_{n-1} is the standard deviation estimate.

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