PN-ABC-055

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1. Project/Subproject Number: 936 - 4084

2. Contract/Grant Number:

3. Publication Date:

4. Document Title/Translated Title:

5. Author(s)
1.
2.
3.

6. Contributing Organization(s):

7. Pagination:

8. Report Number:

9. Sponsoring A.I.D. Office:

10. Abstract (optional - 250 word limit)

1. Li, Elton and Arthur Stoecker. "APAP Shortcourse: Microcomputer Applications in Agricultural Development: Participants Manual, Parts I-II." September 1988.

The manual contains the lecture notes and laboratory exercises for a six-week course in microcomputer applications in developing economics, offered by Oklahoma State University under the Agricultural Policy Analysis Project (APAP). The course offered training in analysis of real world problems, hands-on experience with microcomputers, exposure to proven analytical methods and software, and instructions by senior analysts. Participants had the opportunity to develop the knowledge and skills needed to use microcomputers for gathering, processing and analyzing information.

11. Subject Keywords (optional)
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AGRICULTURAL POLICY ANALYSIS PROJECT

Under contract to the Agency for International Development, Bureau for Science and Technology, Office of Agriculture
Project Office 4250 Connecticut Avenue, N.W., Washington, D.C. 20008 • Telephone: (202) 362-2800

ISN 30831

APAP SHORTCOURSE:
MICROCOMPUTER APPLICATIONS
IN AGRICULTURAL DEVELOPMENT
PARTICIPANTS MANUAL, PARTS I-II

By: Elton Li
Arthur Stoecker

SEPTEMBER, 1988

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Oklahoma State University, Department of Agricultural Economics, Stillwater, Oklahoma 74078 • (405) 624-6157

MICROCOMPUTER APPLICATIONS IN AGRICULTURAL DEVELOPMENT PARTICIPANTS MANUAL PARTS I - II

PREPARED FOR

USDA / OICD / MANAGEMENT SERVICES

by

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Stillwater, Oklahoma
August 1988

Published as Agricultural Policy Analysis Project

Report A-48

Second Edition

SHORTCOURSE

MICROCOMPUTER APPLICATIONS IN AGRICULTURAL DEVELOPMENT

Department of Agricultural Economics

Oklahoma State University

GENERAL INFORMATION

Hours	8:30am to 11:30am 1:30pm to 4:30pm
Place	Rm 408 Agricultural Hall
Department Head	Dr. James Osborn (Rm 308)
Training Co-Leaders	Dr. Art Stoecker (Rm 312) Dr. Elton Li (Rm 521)
Other Instructors	Dr. Dan Badger (Rm 322) Dr. Francis Epplin (Rm 416) Dr. Darrel Kletke (Rm 323) Dr. Daryll Ray (Rm 311) Dr. Dean Schreiner (Rm 319) Dr. James Trapp (Rm 317) Dr. Luther Tweeten
Other Information	Office of International Programs Telephone: 744-6535

COURSE OUTLINE

WEEK 1:

Monday	Welcome session: (All instructors) *Lab*: Lesson 1: Introducing the IBM PC microcomputer. Microcomputer operation basics. Introduction to electronic spreadsheets.

Tuesday	Instructors Li and Stoecker *Lecture*: Concepts of electronic spreadsheets. Simple concepts of financial analysis. *Lab*: Lesson 2: Simple financial calculation with Lotus 1-2-3.
Wednesday	Instructors: Li and Stoecker *Demonstration*: Elementary applications of spreadsheet programs. *Lecture*: Diskette handling and elementary DOS commands. *Lab*: Lesson 3: Elementary DOS commands.
Thursday	Instructors Kletke, Li and Stoecker *Lecture*: Enterprise budgeting. *Demonstration*: Microcomputer budget generators. *Lab*: Lesson 6: Budgeting with microcomputers.
Friday	Instructors Epplin, Li and Stoecker *Lecture*: Applications of linear programming I. *Demonstration*: Linear programing software on microcomputers. *Lab*: Lesson 7: Part I. Linear programming matrix design with microcomputers.

WEEK 2

Monday	Instructors Li and Stoecker *Discussion*: The role of microcomputers in development *Lecture:* Business presentation graphics with Lotus 1-2-3 *Lab*: Lesson 4: Business presentation graphics with Lotus 1-2-3
Tuesday	Instructors Li and Stoecker *Lab*: Lesson 5: Using a spreadsheet to summarize information from a market price survey. Review: Design a worksheet to report rice sales.
Wednesday	Instructors Epplin, Li and Stoecker *Lecture*: Applications of linear programming II *Lab*: Lesson 7: Part II. An introduction to linear programming: a MUSAH tutorial.
Thursday	Instructors Tweeten, Li and Stoecker *Lecture*: Introduction to agricultural policy analysis: the analytical programs and tools, Part I. *Lab*: Lesson 8: Part I. A Lotus 1-2-3 implementation of the calculation of the costs and benefits of government policies.
Friday	Instructors Tweeten, Li and Stoecker *Lecture*: Introduction to agricultural policy analysis: the analytical programs and tools, Part II. *Lab*: Lesson 8: Part II. A Lotus 1-2-3 implementation of the calculation of the costs and benefits of government policies.

WEEK 3:

Monday	Instructors Schreiner, Li and Stoecker *Lecture*: Investment and Project Analysis I *Lab*: Lesson 10: Agricultural project analysis with microcomputer spreadsheet programs.
Tuesday	Instructors Schreiner, Li and Stoecker *Lecture*: Investment and project analysis II. *Lab*: Lesson 11: Agricultural project analysis with microcomputer spreadsheet programs.
Wednesday	Instructors, Schreiner, Li and Stoecker *Lecture*: Investment and project analysis III. *Lab*: Lesson 12: Agricultural project analysis with microcomputer spreadsheet programs.
Thursday	Field Trip. Leaders, Li and Stoecker
Friday	Field Trip. Leaders, Li and Stoecker

WEEK 4:

Monday	Instructors Trapp, Li and Stoecker *Lecture*: Introduction to simulation and systems modeling. *Lab*: Lesson 13: Developing a generalized equilibrium spreadsheet simulation model, Part I.
Tuesday	Instructors Trapp, Li and Stoecker *Lecture*: Case study of the use of supply and demand elasticity estimates to build a spreadsheet econometric simulation model of an agricultural economy. *Lab*: Lesson 14: Use of an electronic spreadsheet simulation model for the agricultural economy: the GESS model, Part II.
Wednesday	Instructors Trapp, Li and Stoecker *Lecture*: Applications of simulation and system modeling. *Lab*: Lesson 15: Random numbers: their generations and applications.
Thursday	Instructors Ray, Li and Stoecker *Lecture*: Statistical and econometric methods I. *Lab*: Lesson 16: Matrix and regression facilities of Lotus. Lesson 17: Multiple regression using TSP.
Friday	Instructors Ray, Li and Stoecker *Lecture*: Lesson 18: Advanced disk operating system (DOS) commands. *Lab*: Lesson 19: Advanced DOS commands.

WEEK 5:

Monday	Instructors Ray, Li and Stoecker *Lecture*: Statistical and econometric methods III. *Lab*: Lesson 19: Statistical and econometric analysis with microcomputers.

Tuesday	Instructors Li and Stoecker *Discussion*: Applications of microcomputers in development. *Lecture*: Database: a primer. *Lab*: Lesson 20: Database facilities of Lotus 1-2-3.
Wednesday	Field Trip Leaders, Li and Stoecker
Thursday	Field Trip Leaders, Li and Stoecker
Friday	Field Trip Leaders, Li and Stoecker

WEEK 6:

Monday	Instructors Li and Stoecker *Lecture*: Use of microcomputers for data management. *Lab*: Lesson 21: Introduction to Reflex: the database manager.
Tuesday	Instructors Li and Stoecker *Lecture*: Use of microcomputers for data management. *Demonstration*: Microcomputer database packages. *Lab*: Lesson 22: Using Reflex to derive production coefficients by size of operation.
Wednesday	Instructors Li and Stoecker *Lecture*: Project management with microcomputers. *Lab*: Lesson 23: Application of the search and crosstab features of Reflex to determine the nature of changes in the swine industry in the Dominican Republic.
Thursday	Instructors Li and Stoecker *Discussion*: Microcomputer hardware and software selection. *Lecture*: Lesson 24: Desinging a report with Reflex2. *Lab*: Lesson 25: Translating a Lotus 1-2-3 file to Reflex.
Friday	Instructors Li and Stoecker Backing up diskettes and final instructions.

COURSE INTRODUCTION

Rationale

Agricultural policy in developing countries often has fallen short of serving needs of decision makers and society at large for numerous reasons. Two of the most important reasons have been inadequate data and inadequate policy analysis. The modern microcomputer potentially can place powerful data processing and analysis capabilities within the hands of analysts and technicians in developing countries.

The short course in microcomputer applications in development is an attractive and affordable option for upgrading capabilities of indigenous technicians and analysts. This course offers training in analysis of real world problems, hands-on experience with microcomputers, exposure to proven analytical methods and software, and instruction by capable senior analysts. This short course has been tested previously, and those teaching the course have had experience with policy analysis in a large number of developing countries. The lectures, laboratories, discussion, demonstration, and field work all combine to develop confidence and capabilities in trainees. These data processing and analytical capabilities can provide a continuing source of professional information to local decision makers.

Participants will develop the knowledge and skill to

1. Determine how a microcomputer can assist with the gathering, processing, and analyzing of information.

2. Develop the appropriate format for analyzing data using microcomputers.

3. Interpret and use the information.

Course Overview

This is a six week short course. Dates are June 27 to August 5, 1988. The microcomputer part of the instruction will be conducted on IBM PC or compatible computers. Instruction will be delivered in English.

Software which is included as part of the course includes

O'Leary T.J. *The Student Edition of Lotus 1-2-3*, Addison-Wesley, Benjamin/Cummings, New York. 1987.

Lilien, D.M and R.E. Hall, *MicroTSP: Student Version User's Manual*, Quantitative Micro Software, Irvine, California, 1986

Borland, *Reflex: The Database Manager User's Manual*, Borland/Analytica, Inc. Scotts Valley, California, 1985

Reference Materials and Software

Data from Participants' Own Country

The participants are requested to bring some data from their work for use in individual projects. If possible, the data should be in IBM PC readable format on floppy diskettes in addition to hard copies.

Trademarks Referenced

Several Trademarks are referenced throughout this manual. These are LOTUS 1-2-3 which is a trademark of LOTUS Development Corporation, IBM PC which is a trademark of International Business Machines, TSP which is a trademark of TSP International, Reflex which is a trademark of Borland International, and MSDOS which is a trademark of Microsoft Corporation.

Lesson 1

INTRODUCTION TO IBM PC COMPUTER AND LOTUS 1-2-3™

Prepared by A. Stoecker and E. Li

OBJECTIVES

The objective of this lesson is to provide a quick start on the IBM Personal Computer (IBM PC) and the Lotus 1-2-3 spreadsheet package. Specific Topics include

a. Definition of common terms used in computing
b. Turning on the computer and starting Lotus program
c. Review of the Lotus Access Menu Program
d. Develop a simple spreadsheet.
e. Saving and retrieving worksheets to/from the disk.

BASIC TERMINOLOGY

A microcomputer or a personal computer usually refers to a computer which is small enough to sit on your desk; usually intended to accommodate one user at a time. A mini-computer or a mainframe computer, is a larger computer, usually centrally located and generally designed to accommodate many users at a time.

The heart of any computer is called the central processing unit (CPU). As its name implies, the CPU processes. The "thing" which CPU processes is information or data. The CPU for the IBM PC family of PC's is the 8088 family of microprocessors design by Intel.

Information is represented inside the computer by bits. A bit by itself is not very interesting. It is either ON or OFF (or 1 or 0).

A group of 8 bits is called a byte. An example of information in a byte would be 10010000. Another example is 00001010. Since there are $2^8 = 256$ possible combinations of 0's and 1's in a sequence of 8 bits, a byte can represent 256 "things". For example, a byte can be used to represent the English character set which with lower case and upper case digits, the numerals, punctuations and special symbols and characters, among to 256 distinct characters. The letter 'A', for example, is represented by the byte representation 01000000. The letter 'a' is represented by 01100000. The numerical '1' is

represented by 00110001. Thus a byte's worth of information amounts to about one character of information. In this context, byte and character are sometimes used interchangeably.

The CPU by itself can only store a few bytes of information. To perform anything useful, the CPU needs a "scratch pad". This "scratch pad" is the Random Access Memory (RAM) of the computer. A modern microcomputer typically contains sufficient RAM to hold about 256K to 640K characters. Where 1K is equal to 1024, or roughly 1,000.

RAM memory has one major deficiency: it forgets whenever electricity is turned off. To store information or program permanently, disk storage is needed.

A *floppy diskette* is a flexible disk used for permanent storage of data or programs. A new diskette must be *formatted* before it can be used. The standard IBM PC diskette is formatted to hold 360K bytes or characters of information. Floppy diskettes are removeable from their disk drives.

A *hard disk (or fixed disk)* is a large capacity non-removable disk which is commonly designed to hold 10-40 million characters (mega bytes) of information. Hard disks are also faster than floppies.

GETTING STARTED

Turning on the Computer

(1) Insert the Lotus 1-2-3 system disk in Drive A and put the data disk in drive B. (On systems where disk drives are stacked on top of each other, drive A is the top drive and drive B is the bottom drive, on systems where disk drives are side by side, the left hand drive is drive A, the right hand drive is drive B). In most instances, you will put the disk containing the program in drive A and the data disk in drive B.

(2) Turn on both the computer monitor and the computer main unit. The power switch on the monitor is in the front. The power switch of the computer main unit is at the back and on the right.

(3) After a minute or so, the disk will spin and after a while, you will see the message:

Enter todays date in a month, day, year format.

You should then respond by entering todays date. For the date, June 29, 1987 you would ***type 6-29-87.*** Entering means typing in the text and then press the ***Enter*** key.

2

On some systems, the enter key is a grey key labeled with ←| On other systems, the enter key is also called return key and is labelled 'return'.

(4) You will then be asked to enter the correct time of day. Time is entered on the basis of the 24 hour clock. For example, enter 10:30 for 10:30 am or 22:30 for 10:30pm.

(5) You should now see the symbols:

A>

This is the DOS (Disk Operating System) prompt. When you see the DOS prompt (A>) it means

a. That drive A has been designated as the primary drive. Unless designated otherwise, the computer will expect any programs which are to be executed to be on the disk in drive A.

b. That the computer is waiting for you to enter the name of a command or program to be executed.

c. It is safe to open the disk drive latch and change disks when the DOS prompt is showing. Note that each drive has a red light which is on when the disk drive is turning. The drive is turning when the computer is reading information form the disk or writing information to the disk. Do NOT attempt to change diskettes when the drive light is on.

INTRODUCTION TO ELECTRONIC WORKSHEETS WITH LOTUS

EXERCISE 1. USE A SPREADSHEET TO CALCULATE BASIC STATISTICS

At the completion of the following exercise you should be able to

1. Enter the Lotus Worksheet.
2. Understand how to design a worksheet.
3. Enter Data, Formulas, and Labels into the worksheet.
4. Save the worksheet file to disk.
5. Print out the worksheet.
6. Use the COPY command to replicate formulas.

DIRECTIONS

1. ***INSERT THE LOTUS SYSTEM DISK IN DRIVE A.***
2. ***PLACE A FORMATTED DATA DISK IN DRIVE B.***
3. ***TURN ON THE COMPUTER***
4. ***ENTER THE DATE AND TIME OF DAY WHEN REQUESTED.***
5. ***WHEN YOU SEE THE A>***
   A> LOTUS <-type LOTUS when you see the A> prompt.
6. ***You should see the LOTUS system menu shown below.***

```
| 1-2-3 PrintGraph Translate Install View Exit
| Enter 1-2-3 -- Lotus Worksheet/Graphics/Database program
```

Figure 1. Lotus Access System Menu.

The Access System lets you choose on of the following:

1-2-3. This is the main spreadsheet program and is the option you will use most often.

PrintGraph This is used to print out any graph which you may have previously created with 123. This program is on another disk and you will have to change the disk in drive A to run this program.

Translate This program is used when you want to convert files from a form used by Lotus to those used by another program or when you want to convert files used by another program into a form which can be used by Lotus. This program is also on another disk.

Install This program is used when you are first installing Lotus on your computer. This program is on the installation disk.

View This is a tutorial which gives you an overview of Lotus .

Exit Leave the Lotus Access System and return to DOS.

To start a program use the -> key [RIGHT arrow] or <- key [LEFT arrow] to move the menu pointer (the highlight bar at the top of the screen) to the program you want to use, then Press ***[RETURN]*** to start the program. You can also start a program by typing the first letter of the menu choice. Press ***[HELP]*** which is the ***[F1]*** key for more

information. If you're using a diskette system, the Access System may prompt you to change disks.

For now, ***move the cursor so 1-2-3 is highlighted*** and press the ENTER key.

You should see the blank Lotus worksheet shown below. Note the columns are labeled or designated with letters of the alphabet while the rows are designated with numbers. The position of the cursor is indicated by the white bar in the screen and the position is also listed at the top of the screen. The word READY at the top right of the screen indicates that LOTUS is ready for input and calculations. The time and date appear at the bottom left corner of the worksheet.

```
A1:     denotes cell where cursor is located  READY
   A   B   C   D   E   F   G   H
1 [cursor]
2          columns are referred to by letter
3
4
5      rows are referred to by number
6
7
8
9                  time and date
29-Jun-87 10:30 AM
```

Figure 2. Lotus Worksheet

EXPLORING THE WORKSHEET

The cursor is moved (scrolled) by using the arrow keys on the numeric pad on the right of the keyboard. Note that as you scroll to the right the letters at the top of the screen begin to change. As you scroll down the row numbers also begin to change. The worksheet has a total of 256 columns and 8192 rows.

SPECIAL KEYS

HOME key on the numeric keypad moves the cursor to cell A1.

END key on the numeric keypad moves the cursor to the end of the worksheet.

PgUp key moves the cursor up one page

PgDn key moves the cursor down one page

Ctrl-> key moves the cursor one page to the right (hold down the ctrl key while you press the right arrow key).

Ctrl<- key moves the cursor one page to the left. (hold down the ctrl key while you press the left arrow key).

FUNCTION KEYS

The function keys are the keys which are numbered F1 - F10 on the left side of the keyboard. The purpose of the function keys is:

F1 Help	F2 Edit
F3 Name	F4 Absolute
F5 Go To	F6 Window
F7 Query	F8 Table
F9 Calculate	F10 Graph

Three of the above function keys are of immediate use. These are:

F1 Help key. This key will cause the computer to provide you with information about various keys and commands. If you press the F1 key you should see the information show below in Figure 3. Use the arrow keys to move to a topic for which you wish information. Press the enter key. Press the ESC key to return to the worksheet when you have finished.

F2 (EDIT) key. This key lets you edit the contents of the cell under the cursor. Press the ENTER key when you have finished editing.

F5 (GO TO) key. When the F5 key is pressed, you will see the message Enter Address to go to:A1
To go to the last row of the worksheet, enter A8192. Press the HOME key to return to cell A1.

(notes)

A1: HELP

READY Mode

The mode indicator, READY, in the upper right corner of the screen means you can select a command or type a cell entry. The first key you press determines your action:

Formula or Number:	Type a digit (0..9) or one of the characters +, -, ., (, @, #, or $.
Label:	Type any character except those that begin with a formula or number. Start with a label-prefix character to create a label of a particular type: ' for a left-aligned, " for a right-aligned, ^ for a centered, or \ for a repeating label.
Command:	Type /.
Special Function:	Press a special key.

To learn more about this Help facility, press [END], then [RETURN]

Cell Entries Mode Indicators
Help Index How to Use Help

Figure 3. Lotus Help Menu.

WORKSHEET DESIGN

A spreadsheet is designed to work with rows and columns of data. However, much of the power of a worksheet is derived from its ability to handle WHAT IF questions. That is the worksheet should be designed so that results can be quickly recalculated if basic data or parameters are changed.

A problem is entered into a spreadsheet the same way it would be entered onto a sheet of paper which had been ruled with rows and columns. First one would enter labels to identify the data contained in the rows and columns. Then one would enter the raw data. Finally one would do the calculations and record the results in the appropriate cells of the worksheet.

In the following exercise, a staff member is attempting to find the mean and standard deviation of some crop yields over a five year period. A hand calculated version of the problem would look as shown in Figure 4a.

	A	B	C	D
1		Yield	Yi-Ybar	Squared
2	Year	(bus)		deviations
3	1981	35	0.83	0.69
4	1982	25	-9.17	84.03
5	1983	40	5.83	34.03
6	1984	30	-4.17	17.36
7	1985	40	5.83	34.03
8	1986	35	0.83	0.69
9		--------		-------
10	Total	205		170.83
11	Average	34.17	Variance	34.17
	12		Std. Dev.	5.85

Figure 4a. Problem Design for Calculation of Mean and Standard Deviation of Crop Yields.

In the hand calculated example, the user might use the first row of the worksheet to enter the column names and the first column of the worksheet might be used to enter labels for the rows. The sum of the yield is contained in cell B10 and the mean or average is recorded in cell B11. In this example the data is entered in column B. To calculate the variance and standard deviation of the yields, the following formulas might be used.

$$Ybar = \sum_{i=1}^{n} Yi/n \tag{1}$$

$$Var = \frac{\sum_{i=1}^{n} Yi/n\ (Yi - Ybar)^2}{(n - 1)} \tag{2}$$

$$Std = Sqrt(Var) \tag{3}$$

The hand calculations can be done in the following steps.

1. Subtract the mean yield (in cell B11) from each yield in column B. Store the result in Column C.

2. Square the value in column C, rows 3 through 8. Record the result in column D.
3. Sum the squared residuals in column D, rows 3 through 8 and record the sum in cell D10.
4. Divide the amount in cell D9 by 5 or n-1 to get the variance. Record the result in cell D11.
5. Standard Error: Take the square root of the variance (stored in D11). Record the result in cell D12.

The first principle in designing a worksheet is to determine what data must be entered directly into the worksheet and which numbers can be generated or calculated by the computer. The objective is to make the computer work for you rather than you working for the computer. In the above problem, the only numbers which cannot be calculated are the observed yields for 1981 through 1986. All of the remaining values can be calculated by the use of formulas.

The full set of formulas required to perform the calculations is shown below in Figure 4b in the cell where the formulas are really entered. The use of each formula is described by the steps outlined below.

	A	B	C	D
1		Yield	Yi-Ybar	Squared
2	Year		(bus)	Deviations
3	1981	35	+B3-B11	+C3*C3
4	1982	25	+B4-B11	+C4*C4
5	1983	40	+B5-B11	+C5*C5
6	1984	30	+B6-B11	+C6*C6
7	1985	40	+B7-B11	+C7*C7
8	1986	35	+B8-B11	+C8*C8
9		----		----------
10	Total @SUM(B3..B8)			@SUM(D3..D8)
11	Average	+B10/6	Variance	+D10/5
12		Std. Dev.		@SQRT(D11)

Figure 4b. Worksheet Formulas to Calculate Mean and Standard Deviation of crop yields

CALCULATE THE SUM OF THE YIELDS

A formula is used to tell Lotus how to calculate the values in a cell of the worksheet. ***The formula entered in cell B10 is @SUM(B3..B8).***

This formula tells the computer that the value to be stored in cell B10 is the sum of the values in column B in rows 3 through and including row 8.

CALCULATE THE MEAN

The next step is to calculate the mean or average. The sum or total has been stored in cell B10. The average (to be stored in cell B11) is calculated by dividing the sum by the number of observations. The formula is ***+B10/6***

The + symbol which proceeds the B10 is to help Lotus distinguish between whether a formula or a label is being entered into a particular cell of the worksheet. If the first character which is typed is a digit 0-9, +, -, 0 or @ then Lotus assumes that a formula or a value is being entered. Otherwise Lotus will assume the cell entry is to be a label.

CALCULATE THE DEVIATIONS

The deviations are calculated by subtracting the mean from each observation. ***For 1981, the formula entered into cell C3 is +B3-B11.*** For 1982, the formula in ***Cell C4 is +B4-B11.*** The formulas are similar for 1983 through 1986.

SQUARE THE DEVIATIONS. (in cells D3 through D8).

The square of each deviation in column C is stored in Column D. ***The formula typed in cell D3 for 1981 is +C3*C3.*** For 1986 the formula is +B8*B8. Note that an equivalent formula for cell D3 would be +C3^2. The ^ symbol is used to indicate exponentiation.

SUM THE SQUARED DEVIATIONS. (in cell D10).

The formula @SUM(D3.D8) tells Lotus to sum the values in column D from row 2 to and including row 8. The result is stored in the cell where the formula is located.

CALCULATE THE VARIANCE (in cell D11).

The variance is calculated by dividing the sum of the squared deviations (in cell D10) by the number of observations less one. ***The formula typed into cell D11 is +D10/5***

CALCULATE THE STANDARD DEVIATION (in cell D12).

The standard deviation is the square root of the variance. ***The formula typed into cell D12 is @SQRT(D11).***

SAVING YOUR WORKSHEET ON A FLOPPY DISK

The worksheet you have created is now stored in the RAM part of the computer. When the computer is turned off any programs and data in RAM are lost. We will use the File save commands to save a permanent copy of your work on the disk in drive B.

Press the / key. You will see the following Lotus Command menu at the top of the screen.

Worksheet Range Copy Move File Print Graph Data System Quit
Global, Insert, Delete, Column, Erase, Titles, Window, Status, Page

Figure 5. Lotus Command Menu

The top row of the command menu are lists of Lotus commands. The command "Worksheet" should be highlighted. The second row is a short explanation of the actions performed by the highlighted command.

Use the arrow keys to move the cursor to the word File on command line and ***press the ENTER*** key. You will see the following sub-menu.

Retrieve ***Save*** Combine Xtract Erase List Import Directory
Store the entire worksheet in a worksheet file

Use the arrow key to highlight the word Save and press the ENTER key. You will see the following prompt.

Enter save file name: A:\

The A:\ means that the data will be stored on drive A. Our data disk is in drive B.

Use the backspace key at the top of the keyboard to remove the A:\

Now ***type in B:MEANSDEV*** at the prompt as show below and ***press*** the ***ENTER*** key

Enter save file name: ***B:MEANSDEV***

The red light should glow on drive B as the file is being saved. When the computer has returned to the ready mode your data set has been saved and you can safely exit the worksheet.

The file saving process can also be done by typing the first letter of each word on the command line. The sequence to save a file is

/FS filename (enter)

RETRIEVING A PREVIOUSLY SAVE WORKSHEET

To load a previously stored worksheet, type

/ to get the Lotus command line

F for File or use the arrow key to move the cursor to the word File, Press ENTER.

R for retrieve or move the cursor to Retrieve and press ENTER.
Type the filename and press ENTER or move the cursor over the name of one of the files listed on the command line and press ENTER. The selected file will be loaded into the spreadsheet.

QUITTING THE WORKSHEET

To exit the Lotus worksheet ***press the / key.*** You will see the Lotus command menu shown above in Figure 5. Either ***type Q*** (for quit) or use the arrow key to move the cursor to Quit and press ***ENTER***

Lotus will respond with the following prompt.

No Yes
Do not end 1-2-3 session; return to READY mode

This is your last chance to save your work. If your work has been saved, either

type Y or use the arrow key and move the cursor to
Yes and press ***ENTER.***

The computer will return you to the LOTUS access menu shown in Figure 1. ***Choose Exit*** to return to DOS.

After you see the A> you can remove the diskettes from the machine and turn the computer off.

Lesson 2

SIMPLE FINANCIAL CALCULATIONS WITH LOTUS 1-2-3

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OBJECTIVES

This lesson has two major objectives. One objective is to review basic financial calculations that will be used later in the course. The second objective is to demonstrate how Lotus 1-2-3 can be used for simple financial calculations. We will develop two LOTUS templates.

The first template will deal with compounding. It helps answer questions such as:

"What will I receive in 5 years if I put $1,000 in a savings account which pays 12% interest compounded annually?"

The second template will concern evaluating investment opportunities using the Net Present Value approach. This approach requires that future earnings (i.e. amount received less expenses) from an investment be discounted to their worth at the present date -- the inverse operation of compounding. The sum of these discounted future net cash flows less the initial cost of the investment is the Net Present Value (NPV) of the investment. It provides a basis for evaluating the investment's viability in itself and for comparison with other investment opportunities.

This lesson does not use the more progressive financial functions of LOTUS since one objective of the lesson is to cover some of LOTUS's basic commands. The more advanced financial features of LOTUS will be covered in a later session. Specific Lotus commands which are discussed in this lesson include

a. Entering financial formulas in the worksheet
b. Using Repeating labels
c. Setting Column Widths in the worksheet
d. Using the Range Format Command to change the data appearance.
e. Using the Data Fill Command.
f. Using the Net Present Value Formula.

COMPOUNDING

Review of Concept

Let's say you put Z dollars in a savings account which pays r percent interest compounded annually. At the end of the first year, the interest payment for your Z dollars would be:

$$z\left(\frac{r}{100}\right) \tag{1}$$

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which is simply r percent of Z. And the ending amount for the first year would be

$$z + z\left(\frac{r}{100}\right) \tag{2}$$

or:

$$z\left(1 + \frac{r}{100}\right) \tag{3}$$

This ending amount (or balance) for the first year would become the beginning amount for the second year. The interest for year 2 is r percent of the beginning amount of year 2:

$$\left\{z\left(1 + \frac{r}{100}\right)\right\}\frac{r}{100} \tag{4}$$

The ending amount for the second year is the beginning amount for year 2 calculated in (3) plus the interest calculated in (4):

$$\left\{z\left(1 + \frac{r}{100}\right)\right\} + \left\{z\left(1 + \frac{r}{100}\right)\right\}\frac{r}{100} \tag{5}$$

Grouping like terms in (5), we arrive at:

$$\left\{z\left(1 + \frac{r}{100}\right)\right\}\left\{1 + \frac{r}{100}\right\} \tag{6}$$

or simply:

$$z\left(1 + \frac{r}{100}\right)^2 \tag{7}$$

The ending amount for the second year (7) in turn becomes the beginning amount for the third year. In general, the ending amount for the n-th year is:

$$z\left(1 + \frac{r}{100}\right)^n \tag{8}$$

or expressed in "computerese":

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Z*(1+r/100)^n
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The LOTUS Implementation: Discussion

The LOTUS template in figure 1 implements the concepts discussed above. We will explain in detail the implementation procedure in the next session. For now we will just discuss in general what goes into the template.

The initial deposit, 100 dollars, appears in Cell B8. The interest rate, expressed in percent, is in Cell C2. The interest for year 1, in cell C8, is calculated by the formula similar to equation (2) above:

+C8*(C2/100)

The ENDING AMOUNT for year 1, in cell D8, is simply the sum of the BEGINNING AMOUNT for year 1 (Cell B8) plus the INTEREST for year 1 (Cell C8):

+B8+C8

Now we go on to year 2. The beginning amount for year 2 is simply the ending amount of year 1. Thus in Cell B9, the formula is

+D8

which is the ending amount of year 1.

INTEREST for year 2 is calculated similar to year 1:

+B9*(C2/100)

and year 2's ENDING AMOUNT is

+C9+D9

Calculations are similar for the rest of the years.

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	A	B	C	D
1	COMPOUND INTEREST CALCULATIONS			
2	Annual Interest Rate:		10 Percent	
3	Interest Compounded Annually			
4				
5		Beginning		Ending
6	Year	Amount	Interest	Amount
7				
8	1	100.00	10.00	110.00
9	2	110.00	11.00	121.00
10	3	121.00	12.10	133.10
11	4	133.10	13.31	146.41
12	5	146.41	14.64	161.05
13	6	161.05	16.11	177.16
14	7	177.16	17.72	194.87
15				
16	Final Payment using formula			194.78
17	Present Value of Final Payment			100.00
18				
19				

Figure 1. Lotus Implementation of Compounding

The LOTUS Implementation: Procedure

We aim to produce a template the same as in Figure 1 (but without the row and column designation, of course). Care should be taken in not just duplicating the calculations of the template, but also the formatting and general appearance: we don't just want a LOTUS template that does the calculations, we want a LOTUS template that also looks good.

(1) Setting the column width.

By default, each column of the LOTUS worksheet has a width of nine characters. Sometimes you may want to change this to improve the appearance or spacing in the template. ***In this example, column A is set to a width of 6. Columns B, C and D are set to width of 15.***

To set the column width of column A to 6. ***First position the cursor anywhere in column A.*** Then ***type***:

/ W C S (the first letter of the commands
/Worksheet ***C***olumn ***S***et-width)

When LOTUS asks the width you would like to set, type 6 and press ENTER. Similarly, to set the column width of column B to 15, ***First position the cursor anywhere in column B. Then type:***

/ W C S (for the commands /Worksheet Column Set-width)

and ***then enter 15*** for the column width. ***Repeat for column C and D.***

(2). Entering in the first 3 lines.

In cell A1 enter in the label:

COMPOUND INTEREST CALCULATIONS

Note that the label entered in A1 is "spilled over" to cell B1. In general, if you enter a label which is too long for the cell, the label will "spill over" to the cell on the right if that cell is empty. If the adjacent cell is not empty, then the label will simply be chopped and only the first part of the label will appear.

Similarly in cell A2 enter the label:

Discount Rate:

In cell C2, enter in the number 10, the loan interest rate. In cell D2 enter ***PERCENT***. Note that interest is expressed in percent, not decimal. This should be taken into account as we perform the calculations.

Now complete the labelling for rows 1, 2 and 3.

(3) Draw the line in row 4.

We will first draw the line in cell A4 and then copy that cell to the rest of the row. ***To draw the line in cell A4 enter:***

Note that \ is the back slash, not the regular slash, which is /. The back slash is one of four of the so called "label prefix", the others are ', ", and ^.

Normally, when you enter a label, LOTUS <u>automatically</u> appends ' to the beginning of the label. The ' serves two purposes. First of all, it signifies a label. Second, it left justifies the label in the cell. Left-justification is usually what one wants for labelling. That is why LOTUS supplies that as default.

However, there are times when you want to right justify the label in the cell. In this case, you should precede the label with " when you enter it in. If you want the label to be centered in the cell, you would precede the label with ^. The back slash signifies a "repeating" label. When you precede a label with \, the label will repeat itself in the cell until the cell is filled. In this case, our label is -, and we preceded it with \. So the label - repeats itself in the cell until the cell is filled. The effect is a line ------.

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The advantage of using a repeating label instead of explicitly putting in '------ is that as you increase the column width of A to, say, 12, the repeating label would expand and fill the 12 spaces. Whereas if you had entered '------, you would end up with a "half line" as the column width is expanded to 12.

Now we will use the copy command to copy the line the in cell A4 to the rest of row 4. The copy command is one of the most important command in LOTUS. It's function is to copy the contents of a cell, or a range of cells, to another cell or range of cells.

To use the copy command, you need a "from range" and a "to range". The "to range" is the range of cells you wish to copy to from the "from range". ***To copy the line, first position the cursor in cell A4. Then invoke***

/Copy (by typing /C)

LOTUS then displays:

Enter range to copy FROM: A4..A4

LOTUS is asking you to specify the range you want to copy from. Since your cursor is in Cell A4, LOTUS figures that most likely, this is the range you would like to copy from. That is why it automatically supplies the answer to its own question, in this case the answer is A4.A4. If this is not what you want, you could override this default by typing in another range. Note that A4.A4 is a range of one cell, which is a special case. Usually the range would be a rectangular area of the worksheet, e.g. A4.C10 or C5.E9 etc.

Since A4.A4 is indeed the (range of) cell(s) we would like to copy from, press ENTER to accept LOTUS's intelligent guess.

LOTUS then displays:

Enter range to copy TO: A4

LOTUS is asking you to specify the range you want to copy to. To respond, do the following:

1. ***Move the cursor to B4***
2. ***Type .***
3. ***Move the cursor to D4***
4. ***Press ENTER***

If you do everything right, you should see the line as in Row 4 of figure 1.

(4) Copy the line from row 4 to row 7.

We could repeat the procedure above to come up with the line in row 7. But instead, we will use the copy command to copy the whole line from row 4 to row 7. To do so,

Move the cursor to A4

Invoke the copy command: /Copy

When LOTUS asks for the range to copy FROM, ***type A4.D4***

When LOTUS asks for the range to copy TO, ***type A7***

As a contrast, this time we responded to LOTUS's prompting for ranges by explicitly typing the range in. Last time we did so by using cursor movements to specify the range. Both ways are acceptable. Most people prefer the cursor movement method.

(5) Copy the line from row 4 to row 15 and row 18.

Make sure you use the copy command to do this.

(6) Enter in the labels for rows 5, 6, 16, and 17.

Use the " label prefix to right justify the labels in row 5 and 6 when appropriate.

(7) Fill in the years in A8 to A14.

We will use the LOTUS Data Fill command for this. The Data Fill command lets you fill a range with numbers starting from a specified value and increasing by a specified step. Here our starting value is 1 and the step is also 1, since we want the first year to be 1, the second to be 1+1, the third to be 2+1 and so on.

To use the Data Fill command, ***first move to cell A8. Then invoke***

/Data Fill

now press the . key and then use the down arrow key to expand the cursor until it covers the range A8.A14. Then press ENTER.

For 'Start' enter 1. For 'step', press ENTER to accept the default of 1. ***For 'stop', press ENTER*** to accept the default of 255 for student version.

(8) ***Enter in 100*** as BEGINNING AMOUNT for year 1 ***in cell B8.***

(9) Calculate the INTEREST amount for year 1 ***in cell C8 type the formula:***

+B8*C2/100

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(10) The ending amount for year 1 (cell D8) should be BEGINNING AMOUNT plus INTEREST of the same year. ***The formula for cell D8 is***

+B8+C8

(11) ***In cell B9*** the BEGINNING AMOUNT of year 2 is the ending amount of year 1, i.e. ***+D8***.

(12) Now copy the formulas in the range C8.D8 to the range C9.D9 using the copy command.

First place the cursor in Cell C8. Then type

/C

Specify the FROM range as C8.D8 and the TO range as C9.D9.

If you have followed our procedure closely, Cell C9 (i.e. the interest for year 2) should display zero. But this is not the correct answer! To see why, ***move the cursor to Cell C9 and examine the formula contained there.*** It should show:

+B9*C3/100

whereas the correct formula should be:

+B9*C2/100

Since Cell C3 contains zero (actually blank, which is interpreted as zero by LOTUS), the formula yields zero as the content of cell C9.

How did we come up with this formula in cell C9? We copied it from cell C8 which contains

+B8*C2/100

So why did C2 in this formula change to C3 as we copied the formula from C8 to C9? Answer: the same reason B8 in the formula changed to B9 when copied from cell C8 to C9. But in this later case the change is desirable, since we want year 2's INTEREST to be calculated from year 2's BEGINNING AMOUNT. In fact, this automatic adjustment of cell reference as formulas are copied using /Copy is what makes the command so useful. But there are times when we don't want this automatic adjustment feature. The need to reference the same INTEREST rate in this case is a perfect example.

When we copy formulas to another cells, generally both the row and column of cell designations in the formula will adjust. To prevent one or more cell designations from adjusting as we copy, we must prepare the cell(s) where we are copying from BEFORE the copying is done. ***We prepare as follows: if we do not want the column to vary, prefix the column designation with a dollar sign (e.g. $A12 instead of just A12).*** Likewise, to prevent the row from varying, prefix the row designation with a dollar sign (e.g. A$12 instead of just A12). And to prevent both the row and the column from adjusting, prefix BOTH the row and column designations with dollar signs (e.g. $A$12 instead of just A12). The $ signs in cell designations are meaningful for copying only and will not affect any calculation.

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In our case, the formula in cell C8 is to be copied to other cells and there is a "fixed cell" in the formula, namely cell C2 -- the INTEREST RATE cell. ***Thus we should change the formula in cell C8 to:***

+B8*$C$2/100

This has the effect of "fixing" the reference to cell C2 as the formula is copied from C8 to C9. The reference to cell B8 will adjust to B9 as desired, since no dollar sign is embedded in the B8 term of the formula.

After changing the formula in cell C8, redo the copying. Copy C8.D8 to C9.D9. Convince yourself that C9 now has the right formula.

Copy B9.D9 to B10.D14

Note that we have been copying from one cell to a range of cells before. Now we are copying from one row to a rectangular area.

(13) Enter in the appropriate formulas for cells D16 and D17

Cell D16: +B8*(1+C2/100)^A14

Cell D17: +D16/(1+C2/100)^A14

(14) Format all dollar amounts to display 2 decimal places.

Normally, LOTUS will use what it thinks it the "best" format to display numbers. Sometimes the appearance of the tableau can be improved by controlling the display format of the numbers. This can be done by the /Range Format command. We want the numbers in the areas B8.D14 and D16.D17 to be formatted to display two decimal places. We will do this one area at a time.

To format the area from B8.D14, first position the cursor in cell B8. Then invoke:

/Range Format Fixed

when prompted for the number of decimal places, accept the default of 2 by pressing enter. When asked for the range to format, expand the cursor to cover the range B8.D14 by using the arrow keys. Then press enter.

Area D16.D17 can be formatted in a similar fashion.

(15) Use the template to compute the ending value of the following seven year saving plans:

a. 1,000,000 at 6 percent
b. 8,000 at 12 percent
c. 1,200 at 24 percent

(16) Save the table under the name COMP1

/File Save
Filename: COMP1

NET PRESENT VALUE

In this part of the lesson, you will create a worksheet similar to Figure 2. The worksheet evaluates an investment by calculating its net present value.

	A	B	C	D	E
1	INVESTMENT ANALYSIS USING NET PRESENT VALUE				
2	DISCOUNT RATE		10 Percent		
3	INITIAL INVESTMENT	1000 Dollars			
4					
5					PV of
6		Cash	Cash	Net	Net
7	Year	Inflow	Outflow	Cashflow	Cashflow
8					
9	1	200.00	100.00	100.00	90.91
10	2	150.00	50.00	100.00	82.64
11	3	350.00	50.00	300.00	225.39
12	4	455.00	50.00	405.00	276.62
13	5	500.00	50.00	450.00	279.41
14	6	700.00	100.00	600.00	338.68
15					
16	Total Present Value of Net Cashflow				1293.67
17	Net Present Value of Investment				293.67
18	Net Present Value of Investment using @NPV				293.67
19					

Figure 2. LOTUS Implementation of NPV.

Net present value will be computed in two ways. With the first approach, NET CASH FLOW of each period will be calculated as the difference between CASH inflow and CASH OUTFLOW. The sum of the present values of these (discounted) net cash flows represent the total present value of net cash flow. The initial cost of the investment will then be subtracted from the sum of the present values to yield the net present values of the investment.

The second method uses the @NPV function in LOTUS 1-2-3. The @NPV function calculated the present value of a series of net cash flows for a specified discount rate. It requires two arguments or pieces of information, the discount rate and the net revenue received in each period. The form of the NPV function is:

@NPV(Discount rate%/100, Range)

If the discount rate (in percent) is, say, stored in Cell X23 and the series of cash flows is stored in cell D21 through D28, then

@NPV(X23/100,D21.D28)

returns the total present value of the series of net cash flows located in cells D21 to D28. Subtracting the initial cost of investment from this value yields the net present value of the investment.

Hints for Completion of the Template

1. Column width of column A should be set to 6, columns B to E should have widths of 12.

2. All dollar values should be formatted with 2 decimal places.

3. Formulas should be used for the NET CASH FLOW and the PV of NET CASHFLOW columns.

4. The formula to be used for each entry under the PRESENT VALUE OF NET CASHFLOW column is quite complicated. Remember ^ stands for exponentiation in LOTUS. Enter in the formula in E9 first and then copy it down the column. Remember in E9 some cell references in the formula may need to be fixed for copying later on!

5. TOTAL PRESENT VALUE OF NET CASH FLOW (Cell E16) is the sum of the PRESENT VALUE OF NET CASH FLOW column. Use the @SUM function.

6. NET PRESENT VALUE in cell E17 is TOTAL PRESENT VALUE OF NET CASH FLOW less initial investment.

7. Note that the initial cost of the investment must still be subtracted when using the @NPV function.

8. After the worksheet is completed, save it under the name NPV.

9. By experimenting with the discount rate, find the internal rate of return of this investment. Recall the internal rate of return (IRR) of an investment is the rate of discount which equates the NPV of the investment to zero.

Lesson 3

ELEMENTARY DOS COMMANDS

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OBJECTIVES

The lesson will cover some elementary DOS commands relating to diskette handling. Our objective is not to become computer experts: DOS is really a very deep subject. Only the most experienced of computer programmers understands and can take advantage of DOS. Rather, the objective here is to cover the general concept of DOS and enough instructions about DOS commands to handle most situations faced when using an IBM PC with floppy disk drives.

Specifically, the objectives of this lesson are:

1. Format a brand new diskette so it can be used.
2. Copying a diskette from another diskette.
3. Copying a file.
4. Finding out what files are on the diskette.
5. Changing a file's name.
6. Removing a file from a diskette.

You will need the following to complete this lesson

1. The LOTUS system disk.
2. The DOS system disk.
3. Our Data Disk.
4. A new diskette.

Put a file protect tab on the Data Disk and make sure the LOTUS system disk and DOS system disk have file protect tabs on them. The purpose of putting a protect tab on a disk is to protect the disk from being written on. This is a protective measure to prevent you from accidentally erasing information from these diskettes if you make a mistake in following this lesson.

BACKGROUND

As mentioned in Lesson 1, the heart of the computer is the CPU. The CPU itself has practically no place for storing information. Moreover, it can only act on a small amount of information at a time. For the CPU to perform anything useful, it requires a

"scratch pad" for storing information that it frequently needs as a program is running. That "scratch pad" is RAM (Random Access Memory) or primary memory.

RAM memory is fast, partly because the CPU can use it in a direct manner. But it has two main disadvantages. First of all, it is forgetful, in the sense that it loses memory every time a computer is turned off. Secondly, it is relatively expensive. Most computers only have a limited amount of RAM. A typical IBM PC only has about 256K to 640K bytes of RAM. The earliest microcomputers only had 4K of RAM. Some advanced personal computers nowadays have 8000K of RAM or beyond.

Since information stored in RAM is not permanent and limited in quantity, disk storage is needed. On the PC, the common disk storage media are floppy diskettes and hard disks (or fixed disks). Disk storage is more inexpensive and data and programs stored in disk storage are practically permanent. Disk storage is also referred to as secondary storage, in the sense that the CPU cannot act on the data or programs stored in them directly. This is contrary to RAM, which is sometimes referred to as primary storage. Programs or data must be loaded from disk into RAM before the CPU can operate on them. The traffic that goes from disks to RAM and vice versa is controlled by a computer program. That computer program is the Disk Operating System or DOS. The most popular Disk Operating System on the IBM PC is called MS DOS, where MS stands for MicroSoft: the name of the company that developed this disk operating system. MS DOS runs on computers other than the IBM PC, such as the Wang PC computer. On the IBM PC, MS DOS is usually referred to as PC DOS.

DOS is not an integral part of the computer system. In fact, it itself must be loaded from a diskette into the computer before it can do anything. That is why you must have a diskette in Drive A before you turn the computer on. As the computer is turned on, the first thing it does is to read DOS from the diskette and load it into the computer. The process of loading DOS into a computer is called "Booting the computer". On the IBM PC, the computer can also be booted by simultaneously pressing the Alt key, the Ctrl key and the Del key.

Once DOS is loaded into the system, typically it will prompt you for the date and time. After you entered the date and the time, it displays the prompt:

A>

That means that DOS is ready for you to issue a command.

There is nothing mysterious about a DOS command. You have already been issuing one DOS commands quite routinely already. That DOS command is:

LOTUS

When you type LOTUS and press the Enter key, you are commanding DOS to invoke the LOTUS program, or more precisely, to load the LOTUS program from the LOTUS system disk into RAM and yield control to LOTUS. You know DOS is following your command because the disk drive light would come on, the disk would spin, and after a moment, LOTUS comes up on the screen. From that point on, DOS hands control to LOTUS and you interact with the computer with LOTUS commands, not DOS commands anymore. After you issue the /Quit command and exit LOTUS, control is once again returned to DOS. That is why the A> prompt reappears. From this point LOTUS has been cleared from RAM and you are face to face with DOS again.

DOS COMMANDS RELATING TO DISKETTE HANDLING

The main purpose of this tutorial is to cover the DOS commands relating to diskette handling, the command we will cover are:

DIR	See what files are on your diskettes
COPY	Copy a file to another file
FORMAT	Format a diskette
DISKCOPY	Copy a diskette to another
RENAME	Give a file a different name
DELETE	Delete a file from a diskette

PROCEDURE

The DIR command: To list files stored on a disk

Insert the DOS system diskette in drive A and the Data Disk in drive B. At the DOS prompt, enter:

DIR

you should see the following display on the screen:

Volume in drive B has no label
Directory of A:\

COMMAND	COM	17792	10-20-83	12:00p
ANSI	SYS	1664	10-20-83	12:00p
FORMAT	COM	6912	10-20-83	12:00p
CHKDSK	COM	6400	10-20-83	12:00p
SYS	COM	1680	10-20-83	12:00p
DISKCOPY	COM	2576	10-20-83	12:00p
DISKCOMP	COM	2188	10-20-83	12:00p
COMP	COM	2534	10-20-83	12:00p
EDLIN	COM	4608	10-20-83	12:00p
MODE	COM	3139	10-20-83	12:00p
FDISK	COM	6369	10-20-83	12:00p
BACKUP	COM	3687	10-20-83	12:00p
RESTORE	COM	4003	10-20-83	12:00p
PRINT	COM	4608	10-20-83	12:00p
RECOVER	COM	2304	10-20-83	12:00p
ASSIGN	COM	896	10-20-83	12:00p
TREE	COM	1513	10-20-83	12:00p
GRAPHICS	COM	789	10-20-83	12:00p
SORT	EXE	1408	10-20-83	12:00p
FIND	EXE	5888	10-20-83	12:00p
MORE	COM	384	10-20-83	12:00p
BASIC	COM	16256	10-20-83	12:00p
BASICA	COM	26112	10-20-83	12:00p
23 File(s)			28672 bytes free	

Figure 1. Directory of the DOS System Disk

Well, you actually would not see the whole thing unless your eyes are fairly sharp and fast since the information scrolled by very fast. At the end only the following part of the list is left on the screen:

21'

ANSI	SYS	1664	10-20-83	12:00p
FORMAT	COM	6912	10-20-83	12:00p
CHKDSK	COM	6400	10-20-83	12:00p
SYS	COM	1680	10-20-83	12:00p
DISKCOPY	COM	2576	10-20-83	12:00p
DISKCOMP	COM	2188	10-20-83	12:00p
COMP	COM	2534	10-20-83	12:00p
EDLIN	COM	4608	10-20-83	12:00p
MODE	COM	3139	10-20-83	12:00p
FDISK	COM	369	10-20-83	12:00p
BACKUP	COM	3687	10-20-83	12:00p
RESTORE	COM	4003	10-20-83	12:00p
PRINT	COM	4608	10-20-83	12:00p
RECOVER	COM	2304	10-20-83	12:00p
ASSIGN	COM	896	10-20-83	12:00p
TREE	COM	1513	10-20-83	12:00p
GRAPHICS	COM	789	10-20-83	12:00p
SORT	EXE	1408	10-20-83	12:00p
FIND	EXE	5888	10-20-83	12:00p
MORE	COM	384	10-20-83	12:00p
BASIC	COM	16256	10-20-83	12:00p
BASICA	COM	26112	10-20-83	12:00p
23 File(s)			28672 bytes free	

Figure 2. Directory of the DOS System Disk that Fits on the Monitor Screen

Since the computer monitor screen can only display 25 lines of information at a time, the top part of the screen is scrolled away and there is no easy way to get it back. We will discuss this problem more a little later. But look at what is displayed in figure 1. Ignore the first line for now. The second line says directory of A:\ That means that what is displayed is the directory of the diskette in drive A. Followed is a list of the files that reside in the diskette in drive A, which is the DOS system diskette.

The first item of the list in Figure 1 is:

COMMAND COM 17792 10-20-83 12:00p

That means that the first file on the diskette is COMMAND.COM, the size of the file is 17792 bytes (or characters). The file was last altered the 20th of October, 1983 at 12:00 pm.

Note that the name of the file is COMMAND.COM. The COM part of the name is called the extension part of the file name. A full file name consists of the name part, in this case COMMAND, and the extension part, in this case COM. This convention is similar to the names of persons. The extension part (the part after the period) is comparable to the

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family name. And the reason behind why the full names of files are separated into name part and extension part is similar to why human names are separated into first names and family names. When one is within a family, one need not use the family name. When one is outside the family, one usually uses both first name and family name because it is likely that others may have the same first name. For example, the full name of all LOTUS worksheet files has the extension of WK1. However, within LOTUS, one never need to specify the extension part of the file name. For example the name of a worksheet file might be COMP1 within LOTUS, but actually the full name is COMP1.WK1. Since within the LOTUS "family", all files must have the extension WK1, there is no need to specify the full name. (When my father calls me by my full name, I know I am really really really in trouble!) But when you are in DOS, the LOTUS file COMP1 must be referred to as COMP1.WK1.

Now that we have gotten the naming convention straight, let's discuss the problem of the list of file names scrolling off the screen when the list is too long. In DOS, once anything is scrolled off the screen, you cannot get it back -- it is not like in LOTUS where you can use the PgUp or PgDn key. You probably would not mind so much having part of the list scroll off the screen if you can have a chance to read it before it scrolls off. For the DIR command, if instead of just entering DIR, you ***enter:***

DIR/P

then instead of getting the whole list of files at once, you would get the list of file one screen at a time (try it!). DOS will display the first screen, then pause and ask you to press a key when you are ready to look at another screen of information. Still, you cannot get the screen back once it is scrolled off. But at least you would have a chance to read the screen before it goes away. The /P part of DIR/P is called an option of the DIR command, where P stands for "PAUSE". Another useful option of the DIR command is the /W option, where W stand for "WIDE". ***Enter***

DIR/W

You will see:

```
                    Volume in drive B has no label
-----------------------------------------------------------------------------
Directory of B:\

COMMAND  COM   ANSI     SYS   FORMAT   COM   CHKDSK  COM   SYS      COM
DISKCOPY COM   DISKCOMP COM   COMP     COM   EDLIN   COM   MODE     COM
FDISK    COM   BACKUP   COM   RESTORE  COM   PRINT   COM   RECOVER  COM
ASSIGN   COM   TREE     COM   GRAPHICS COM   SORT    EXE   FIND     EXE
MORE     COM   BASIC    COM   BASICA   COM
      23 File(s)                                28672 bytes free
```

Figure 3. Output of DIR/W

This format does not contain as much information as before: it does not have information concerning the sizes of the files and the dates and times when the files were last altered. But it does reveal what files are on the disk (try it!).

In either formats, the last line of the output gives you the number of files on the diskette and the amount of space unused (or free) on the diskette. In this example, we have 28672 bytes or characters left on the diskette.

We have just described the way to obtain the directory of drive A. To obtain the directory of drive B. ***Enter*** the following:

DIR B:

or

DIR /P B:

or

DIR /W B:

Notice that this time we have explicitly specified drive B. Usually when we refer to a disk drive in DOS we append the drive letter with a colon, for example A: or B:. Why didn't we have to specify the drive explicitly when we asked for the directory for (the disk in) drive A before? It would have worked if we had done that. That is DIR A: would have worked the same as just plain old DIR. The reason is that if we don't specify the drive letter in a DOS command, DOS will assume that you would like to get the directory of the (disk in the) default drive. What is the default drive? Remember the DOS prompt

A>

The A in this prompt means that A is the default drive. When the computer is turned on, DOS assumes the default drive is A, so it displays A>. You can change the default drive to drive B if you want, by simply ***entering***:

B:

Try it! The DOS prompt should now change to B>, meaning that DOS is now assuming drive B is the default drive. ***Now enter***:

DIR

You should get the directory of the diskette in drive B. If you want the directory of the diskette in drive A now, you would have to specify:

DIR A:

Try it! Then change the default drive back to A by entering:

A:

You should leave you default drive as drive A in most circumstances.

EXERCISE: Using drive A, and with the default drive as A:, obtain the directories of (a) The Lotus System Disk (b) The Data Disk (c) The DOS System Disk and (d) the new disk

The FORMAT command: Prepare a disk to store data

When you try to get the directory of the new disk, you would not get a directory. Instead you would get the message:

Disk error reading drive A
Abort, Retry or Ignore?

Press A for abort to get back the A> prompt. The reason DOS says there is an error as you attempt to obtain the directory of a new disk is because the disk has not been formatted. Every new diskette must be formatted before it can be used. Here is how to format a diskette:

With the default drive as A, insert the DOS system disk in A, the new diskette in B, then enter the DOS command:

FORMAT B:

DOS will then load the FORMAT program from drive A and proceed to format the diskette in B. When it finishes, it would ask whether you would like to ***format another diskette? Press N*** for No.

EXERCISE: Obtain a directory of the newly formatted diskette.

Executable Files: COM and EXE

Now look at figure 1, you should find the file FORMAT.COM as one of the files on the DOS System Disk. When we enter FORMAT with the DOS system disk in drive A, DOS would execute the program FORMAT. No, you don't enter FORMAT.COM, just FORMAT. The COM extension is DOS's way to identify that the file is not a data file, but rather a file that is 'executable'. That is, the file is a program that can be loaded and executed. An executable file can either have an extension of COM or EXE.

EXERCISE: Obtain a directory of the Lotus System Disk and see if you can find LOTUS.COM

EXERCISE: Obtain a directory of the DOS System Disk and see if you can find DIR.COM or DIR.EXE.

You can't find DIR.COM or DIR.EXE? No, you are not supposed to. But didn't I say that files which can be loaded and executed must have EXE or COM extension? Yes, but DIR is one of those commands or programs that does not need to be loaded. DIR is always in RAM and thus doesn't have to be loaded every time we need it. It was loaded the first time we BOOTED the computer and remains there as long as the computer remained turned on. These commands are called INTERNAL COMMANDS, contrary to EXTERNAL COMMANDS which must be loaded from disks every time before they can be executed. This may be confusing, but there are only a total of 5 internal commands in DOS, they are: DIR, COPY, ERASE, RENAME and TYPE. All the rest of the DOS commands, in particular the ones we cover in this lesson, namely DISKCOPY and FORMAT, are EXTERNAL COMMANDS. They must be loaded from a diskette before they can be executed. Which diskette should we load DISKCOPY and FORMAT from? Generally the DOS System Diskette, but any diskette with the file DISKCOPY.COM and FORMAT.COM would work as well.

The COPY command: To copy a file

Now insert the Data Disk in drive A and the newly formatted diskettes in drive B. We will copy the file COMP1.WK1 on the Data Disk to the New disk. To do so, ***enter***

COPY COMP1.WK1 B:

Which says: copy the file named COMP1.WK1 from the default drive (should be drive A) to the file with the same name in drive B. Remember that if you do not explicitly specify which drive, DOS will automatically assume the default drive. Thus we could have explicitly specified:

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COPY A:COMP1.WK1 B:

Which says: copy the file named COMP1.WK1 from drive A to the file with the same name in drive B. The two commands would have the same effect if the default drive is A.

If we want to copy COMP1.WK1 from the default drive to drive B and give it a new name, say COMPONE.WK1, we would ***enter:***

COPY COMP1.WK1 B:COMPONE.WK1

Which says: copy the file named COMP1.WK1 from the default drive to the file COMPONE.WK1 in drive B. Try it!!

COMP1.WK1 and COMPONE.WK1 in drive B should have exactly the same contents, since they are copies from the same file, namely COMP1.WK1 in drive A.

Now copy the file COMPONE.WK1 from drive B the drive A. Leaving the default drive as A, ***enter:***

COPY B:COMPONE.WK1 A:

If you have been following the lesson closely, you should get an error message saying that the diskette in drive A is write protected. That should not come as a surprise, since one of the first things we did was to put a write protect tab on the diskette. To rectify the problem, remove the write protect tab and retry the command.

EXERCISE: Obtain a directory of drive A (you should know how to do this by now, I hope). The directory should show COMPONE.WK1 as one of the files in the diskette.

The RENAME command: To rename a file

Suppose for some reason, you don't like the file name COMPONE.WK1 in drive A. You can give the file another name, say, COMPNEW.WK1. To do so, we use the RENAME command. At the DOS prompt A> ***enter:***

RENAME COMPONE.WK1 COMPNEW.WK1

After you have done so, obtain a directory of drive A, you should see the file COMPNEW.WK1 and should NOT see the file COMPONE.WK1 anymore. Since what used to be COMPONE.WK1 is now called COMPNEW.WK1. The contents of the file have not been changed -- only the name.

The DISKCOPY command: To Copy an Entire Disk

We have already covered how a file can be copied from one diskette to another. To copy the contents of the entire diskette to another diskette, one can of course copy each file individually. But an easier alternative is to use the DISKCOPY command, which copies the content of the entire diskette to another diskette.

Suppose we would like to make a copy of The Data Disk on the New diskette. To do so, first insert the DOS diskette in drive A and ***enter:***

DISKCOPY A: B:

which says: I want to copy the disk FROM drive A TO drive B. Remember the FROM diskette or the source disk is listed first, the TO diskette or destination is listed last. DOS then reads the DISKCOPY program from the DOS System Disk. Note that DISKCOPY is not one of the 5 internal DOS commands, it is an external command which must be loaded from a disk which contains a file either named DISKCOPY.COM or DISKCOPY.EXE. Since the DOS diskette contains the file DISKCOPY.COM, DOS thus reads the program DISKCOPY from the DOS disk into RAM for execution. When DISKCOPY begins, it prompts you to insert the source diskette in drive A, destination diskette in drive B and press any key to continue. DON'T PRESS ANY KEY YET!

Before pressing any key to continue the disk copying process, check what are in your drives. One very common mistake is to forget to replace the DOS System disk in drive A with the FROM or source diskette, in this case the Data Diskette. If you forget to replace the DOS system disk in drive A with the source diskette, you would end up copying the DOS diskette to the disk in drive B, which in most cases is not what you want. ***So after carefully checking that drive A contains the Data Disk and Drive B contains the "New" diskette, press any key to begin DISKCOPY.*** When DISKCOPY finishes copying, it asks whether you would like to copy again. Type N for no and return to the DOS prompt.

Lesson 4

INTRODUCTION TO

GRAPHICS IN LOTUS TYPE WORKSHEETS

Prepared by A. Stoecker and E. Li

REFERENCE:

O'Leary T.J. *The Student Edition of Lotus 1-2-3* pp 149-205 and pp 425-435..

BACKGROUND

Lotus contains a Graph command (/G) which allows you to create several different kinds of graphs or charts from the data stored in the work sheet. A graph is a way of presenting two dimensional relationships between the data values in the worksheet. There are five types of graphs: line, XY, bar, stacked bar, and pie charts. To construct a graph you must indicate the ranges of the data to be graphed and the type of graph to use to display the data. Optionally you can improve the graph with titles, labels, legends, colors and crosshatching. In summary, you can:

1. Create graphs using data which has been entered or calculated in the worksheet.
2. Select the colors, plotting symbols, labels and type of graph which best explain the data.
3. Save the graph for later viewing, printing out or plotting.
4. Print the graph on most dot matrix printers.
5. Draw the graph with a pen plotter.

OBJECTIVES

The main objective of this lesson is to present or review the use of graphic commands in Lotus. After this lesson you should:

1. Be able to set up different types of graphs Line, XY, Bar, Stacked Bar, Pie
2. Be able to add titles and legends to the graph
3. View the graph on the screen, change from one type of graph to another.
4. To be able to name graphs for later modification.
5. To be able to save a finished graph for later printing
6. Print the graph on a printer plotter using the Printgraph program which is on another Lotus disk.

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THE GRAPHICS PROGRAM AND COMMANDS

Before you can create a graph, the data must be already entered in the spreadsheet. In this exercise we will use the Net Present Value data created in Lesson 2 to illustrate the use of graphs. ***Use the***

/ File Retrieve filename

commands to load the worksheet shown below into your spreadsheet. The previously created worksheet should appear as

	A	B	C	D	E
1	INVESTMENT ANALYSIS USING NET PRESENT VALUE				
2	DISCOUNT RATE				10 Percent
3	INITIAL INVESTMENT				1000 Dollars
4	---				
5					PV of
6		Cash	Cash	Net	Net
7	Year	Inflow	Outflow	Cashflow	Cashflow
8	---				
9	1	200	100	100	90.90909
10	2	150	50	100	82.64462
11	3	350	50	300	225.3944
12	4	455	50	405	276.6204
13	5	500	50	450	279.4145
14	6	00	100	600	338.6843
15	---				
16	Total Present Value of Net Cash Flow				1293.667
17	Net present value of investment				293.6675
18	Net present value using @NPV				293.6675
19	---				

Discussion of the Graphics Programs and Graphic Commands

(Additional detail about the graph commands can be found in pages 425-435 of the Student Edition of Lotus)

To enter the Graphics Program, type

to get the command line,

use the arrow key to move the cursor to GRAPH

press enter

or type **/G** for / Graphics.

You should see the following menu at the top of the screen

Type X A B C D E F Reset View Save Options Name Quit

Select one of the above commands by using the arrow key to select the desired option and then press the RETURN key

The items shown in the menu have the following purpose:

Select the TYPE of graph.

Move the cursor to the word TYPE and press enter. You will see the following commands in a submenu.

Line	data points connected by a line.
XY	points where the X and Y variables coincide are plotted.
Bar	data points represented by bars
Stacked-Bar	data points from two to six Y variables (A,B,...,F) are shown as parts of a whole
Pie	data points shown as percentages (slices) of a whole (pie)

Select the Variables to be Plotted

X	One data column must be designated as the variable on the X axis. Only one variable may be designated as the X variable.
A	The first Y variable
B	The Second Y variable
C	The third Y variable
D	The fourth Y variable
E	The fifth Y variable
F	The sixth Y variable

Other Commands

Reset	This command resets all graph parameters
View	This command displays the graph on the screen
Save	This command save the graph in a PIC file which can be printed with the Printgraph program

Enhance the Graph

Options	This important command is used to set colors, titles, legends, scaling, and data labels. select Options from the graph menu and you should see the following submenu

Legend Format Titles Grid Scale Color B&W Data-Labels Quit

The commands in the submenu have the following uses:

Legend explanation of plotting symbols, appears below the graph

Format The Format option gives two sub-menus.
The first sub menu is

Graph A B C D E F Quit

This is where you specify whether you want to format the entire graph (Graph) or one of the Y variables.

The second sub menu gives the following options

Lines Symbols Both Neither

Designate your choice and you will be returned to the first sub-menu. Choose Quit to be returned to the Graph menu

Data-Labels
This command places data as labels from the worksheet into the graph. When you select this command you will see the first sub-menu

A B C D E F Quit

You are being asked which variable needs the labels. Select a variable. Then you will go to the second sub-menu and asked if the labels should be

Centered Left Above Right Below

the data points. Make your selection. You will be returned the first sub-menu

Select Quit to return to the main Graph menu.

Quit The Quit command on the main graph menu returns to the main worksheet program.

EXERCISE: CREATING GRAPHS FROM NET PRESENT VALUE DATA

The first exercise will be to develop the line graph shown below in Figure 4.1 from the data in the spreadsheet.

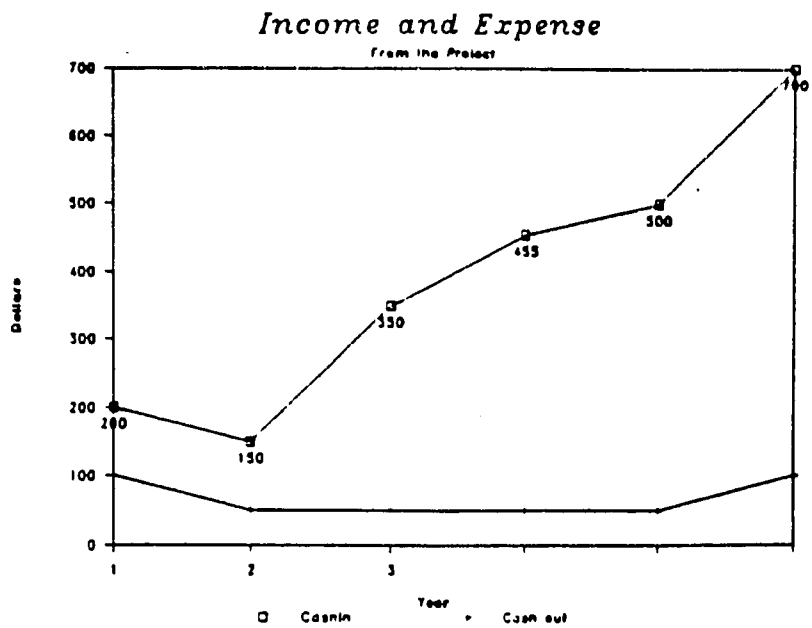

Figure 4.1.

Enter the Graph program with the command /G. You will see the Lotus Graph menu.

Type X A B C D E F Reset View Save Options Name Quit

Select Type with the arrow key and press the RETURN key
You will see the sub-menu

Line Bar XY Stacked-Bar Pie

Line will be highlighted, ***just press enter for a line graph.***

Select the variables to graph. In Figure 4.1, the project years (1-5) are used as the X variable. Two Y variables are used. The first Y variable is the cash inflow each year and the second Y variable is the cash outflow each year.

Select the variable for the X axis.

Move the cursor to X on the command line and ***press Enter***. You will be asked for the range. ***Enter A9.A14***

Select the first Y variable. Let this be the Cashinflow for each year.

Move the cursor on the command line to A, press Enter
Enter the range for A: B9.B14 press enter

Select the second Y variable. Let this variable be Cashoutflow.

Move the cursor to B on the Command line, press Enter
Enter the range for B: C9.C14 press enter

Examine the graph by selecting View on the main graph command line. You should see a graph on the screen which looks like the one in Figure 4.1 above except that the graph has no titles.

Add Legends to the graph to indicate which line is revenue and which line is expense. ***Select the Options command from the main graph menu.*** You will see the following submenu.

Legend Format Titles Grid Scale Color B&W Data-Labels Quit

Select Legends You will be asked to enter a short name for variable A (cashin) and for variable B (Cashout).

Add Titles to be placed at the top of the graph. From the graph menu, Select Options then Titles. You have the following choices

First Second X-Axis Y-Axis

Select the First title line	***type : Income and Expense***
Select the Second title line	***type : From the Project***
Select the X-Axis	***type : Year***
Select the Y-Axis	***type : Dollars***

(note that titles must be 39 characters or less)

Add Legends to the Graph. ***From the main graph menu, select Options***

Type X A B C D E F Reset View Save ***Options*** Name Quit
Legend, Format, Titles, Grid, Scale, Color, B&W, Data-Labels

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Legend Format Titles Grid Scale Color B&W ***Data-Labels*** Quit
Specify label ranges corresponding to data ranges

Select Data-Labels. You will be asked

A B C D E F Quit
Specify data labels for A range

Select A. You will be asked to tell where the observation labels for the a variable are located. We will use the actual data in cells b9.b14 as labels.

Enter label range for A range data: b9.b14
Next Lotus wants to know just where the labels should be placed. You will see the prompt.

Center Left Above Right ***Below***
Place label below data point

Select Below. Return to the main graph menu and View the graph. The graph should look like the one shown in Figure 4.1.

SAVING INDIVIDUAL GRAPHS

You may keep only one unnamed graph in the computer at one time. If you want to go to a second graph, the first graph will be lost unless you save the graph by either the Name create or the Save method. It is important to distinguish between the two commands

Name create ***From the main graph menu, this option lets you name a graph which is kept in the computer memory. This graph can be modified at a later time by using the Name Use command.***

Save ***This option allows you to save a current graph in a special PIC file for later printing with the Lotus Printgraph program. The saved file cannot be further edited or modified by the Lotus Worksheet.***

CHANGING TYPES OF GRAPHS

The data in Figure 4.1 is presented in a Line Graph. In this exercise we will change from a line graph to a Bar graph. From the main menu

Select Type
Select Bar
Select View to see a bar graph like that in Figure 4.2.

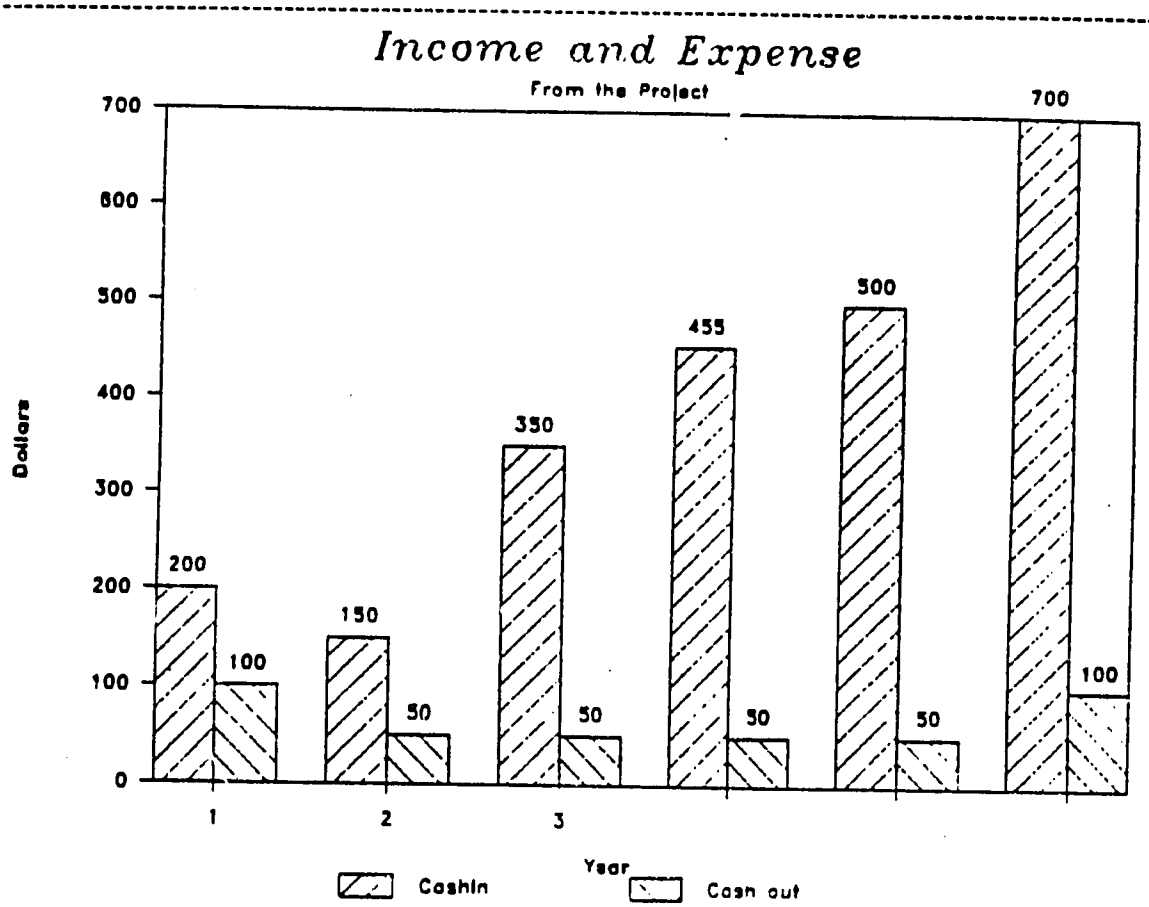

Figure 4.2. Bar Graph of Income and Expense Data.

Change to a Pie graph. The pie graph shows each observation for the A variable as parts of the sum of all observations. In Figure 4.3, the Outflow or expense column was designated as the A variable.

PRINTING A GRAPH FORM LOTUS

The graph must be first completed and saved as a special PIC or graphics file. A separate program (PrintGraph) is used to print the graph.

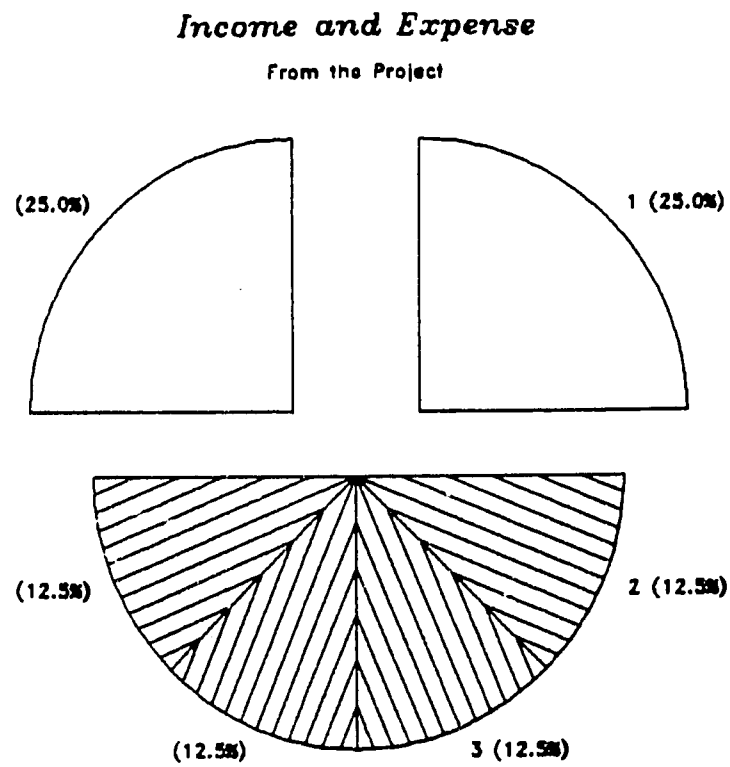

Figure 4.3. Pie Graph Showing Each Year's Expense as a Percent of Total Project Expense.

First, complete the graph with all of the desired legends, titles and other options. When the graph has been completed, from the main GRAPH menu,

Type X A B C D E F Reset View ***Save*** Options Name Quit
Save the current graph in a file for later printing

Select the SAVE option. You will see the following prompt in which you are asked to give a name for the PIC or picture file.

Enter graph file name: B:*.pic

Type a name for the graph file (eg. fig1) and press return. You may want to create several graph files for later printing. Just give each graph file you save a separate name.

Quit the graph menu

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Save your current worksheet with the / F S file name command. Quit the Spreadsheet.

From the main lotus menu

1-2-3 ***PrintGraph*** Translate Install View Exit
Enter Lotus Graphics Printing program

Choose the PrintGraph option. You will asked to change the Lotus system disk for the disk containing the PrintGraph program. You should see the following menu

---

Select graphs for printing
Image-Select Settings Go Align Page Exit

The items below the menu refer to settings in the PrintGraph program. Usually these settings will not have to be changed.
Use the Image-Select Option to select a file. You should see the following sub menu which lists the names of the PIC or graph file on your diskette.

Select graphs for output

PICTURE	DATE	TIME	SIZE
FIG1	07-08-87	13:06	428

Use the arrow keys to select the PIC file you want to print. After you have selected the graph image,press ENTER to return to the main print graph menu.

Image-Select Settings ***Go*** Align Page Exit

Select Go to print the graph. When the graph is finished printing, you can select another image or exit the PrintGraph program.

Lesson 5

USING A SPREADSHEET TO SUMMARIZE INFORMATION FROM A MARKET PRICE SURVEY

Prepared by E. Li and A. Stoecker

OBJECTIVES

A sample of Quantities sold, wholesale price, farmgate price, transportation costs have been collected monthly from the Riverside Market in Manrovia, Liberia. The information collected are as contained in Figure 5.1. Our objective is to:

(1) Present the information in tabular format.

(2) Compute simple descriptive statistics (e.g. average, standard deviation, etc), to summarize information collected.

(3) Design Lotus 1-2-3 graphics to present information collected.

You will be given the Lotus spreadsheet MPRICE which is shown in Figure 5.1. The original contains only the raw information collected, namely, the monthly quantities sold, wholesale prices, farmgate prices, and transportation costs for commodities in the sample. You are to supply the formulas to compute the various total columns or rows, simple averages (Sim Avg), weighted averages (Wt Avg), standard deviation (S.D.), Variance (VAR) and coefficient of variations (C.V.) of the data. You should arrive at the numbers displayed in Figure 5.2. After the data tables have been completed, you will be given an opportunity to present the data in a graphical form. A step by step description of how to complete the data table (shown in Figure 5.2) and the graphs shown in Figures 5.3 and 5.4. An exercise follows in which you are asked to use your knowledge to complete several additional graphs.

Reference: O'Leary, T.J. *The Student Edition of Lotus 1-2-3*, Addison-Wesley Publishing Co. New York,

Copy command pp 123-125, 384, 409-410 @ functions, pp 506-508
Graphics pp 149-204

I. PROCEDURE FOR COMPLETION OF MPRICE WORKSHEET

1. Obtain the annual quantity marketed for each commodity

(1.1) ***Retrieve the LOTUS template MPRICE.*** Explore the contents of MPRICE and compare it with the listing in Figure 5.1.

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(1.2) ***Move the cursor to Cell N6.*** This cell should contain the year total quantities for plantain. We want to add up the quantities marketed each month. The appropriate formula is:

@sum(b6.m6)

Enter it! We need to obtain the annual total for the remaining commodities in rows 7 through 14. Rather than enter separate formulas, use the copy command, to copy the formula in cell N6 to cells N7.N14. To do so, first ***position the cursor at Cell N6. Then type:***

/C

When you see the prompt, "Range to copy FROM", ***press enter*** to accept the default N6.N6. When you see the prompt,"Range to copy TO", ***move the cursor to cell N7, type a dot, then move the cursor to Cell N14. When the expanded cursor covers the range N7.N14, press enter.***

2. *Obtain the Total Quantity of All Commodities for each month*

(Who said you can not add apples and oranges?)

(2.1) ***Move the cursor to Cell B16.*** This cell should contain the total quantity for all commodities marketed during January. The appropriate formula (***enter in cell B16***) is:

@sum(b6.b14).

(2.2) Now we need to obtain the total amount marketed during each of the remaining months and the grand total for the year. Use the /Copy command to copy the the formula in cell B16 to the cell C16 through N16. Enter

/ Copy
FROM: ***b16.b16***
TO: ***c16.n16***

3. *Calculate Weighted Averages for Wholesale Prices*

3.1 Calculate Weighted Averages of data stored by Columns.

We shall now tackle the WHOLESALE PRICE table. We will indicate how to obtain weighted averages of data stored in rows and in columns. In the first case we will obtain a weighted average of all commodities sold in a single month. (Since the commodities in this example are quite diverse, the economic meaning of this quantity is unclear). ***Move to Cell B35.*** This part of the worksheet contains the average wholesale price in the sample. A weighted average is appropriate here to account for the difference in quantities. The formula for weighted average is:

$$\frac{\sum i \; Pi \; Wi}{\sum i \; Wi}$$

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1							WATERSIDE MARKET, MONROVIA												
2							MONTHLY QUANTITIES IN POUNDS FEB 1982 JAN 1983												
3																			
4		Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	total					
5																			
6	Plantain	37,355	24,618	42,061	9,975	25,745	24,583	28,156	19,963	15,032	27,224	20,164	24,7.1						
7	Banana	14,707	24,020	69,507	40,755	47,354	50,076	37,433	43,458	29,272	46,110	44,520	47,033						
8	Pepper	2,615	11,157	13,500	20,175	30,256	31,746	33,975	15,957	12,670	6,480	11,515	5,795						
9	Egg plant	2,280	400	6,655	5,170	6,600	11,095	2,640	1,670	3,673	2,250	3,135	4,142						
10	Bitterbal	45,759	26,268	41,880	25,320	36,780	63,120	44,280	29,526	15,240	7,140	11,840	7,048						
11	Okra	3,908	2,382	1,925	5,280	14,740	28,315	11,880	12,818	9,613	5,610	13,480	9,995						
12	Cassava	34,306	60,527	81,855	36,460	57,805	90,990	54,300	50,525	22,140	11,600	48,060	37,334						
13	Palm Nuts	12,960	9,213	16,560	8,650	14,490	5,120	31,120	33,195	8,003	3,640	13,950	13,057						
14	Palm Oil	3,663	4,921	555	814	3,589	7,511	6,771	3,996	6,623	3,256	1,850	3,663						
15																			
16	TOTAL																		
17																			
18																			
19																			
20							MONROVIA WHOLESALE PRICE (cents per pound)												
21							WATERSIDE MARKET FEB 1982-JAN 1983												
22																			
23		Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Av	VAR	S.D.	C.V.
24																			
25	Plantain	12.20	15.87	12.32	16.75	15.07	11.30	14.11	13.95	14.80	15.75	15.89	14.44	12					
26	Banana	11.50	11.48	10.10	10.10	10.06	9.02	10.57	10.03	11.21	10.76	11.10	11.31	12					
27	Pepper	107.90	89.83	69.01	27.63	16.77	17.90	22.11	29.19	53.68	42.35	56.12	68.97	12					
28	Egg plant	21.00	22.50	23.96	10.07	13.32	15.52	20.11	14.97	20.80	17.33	18.05	17.97	12					
29	Bitterbal	39.20	24.83	23.60	14.10	13.36	13.66	15.88	14.42	24.20	19.75	22.68	36.79	12					
30	Okra	64.60	55.39	42.49	18.90	23.93	13.45	16.44	18.90	28.84	18.60	16.21	28.63	12					
31	Cassava	6.50	7.92	6.18	6.24	6.78	6.72	6.52	6.64	6.27	5.39	5.65	5.68	12					
32	Palm Nuts	13.00	9.51	8.43	8.32	10.60	11.67	11.75	10.40	15.31	12.42	14.49	10.86	12					
33	Palm Oil	79.46	55.88	54.05	54.05	63.22	65.37	68.84	69.46	78.07	67.57	33.70	60.38	12					
34																			
35	Wt. Average													12					
36																			
37																			
38																			
39							MONTHLY FARMGATE PRICE (cents/pound)												
40							FEBUARY 1982-JANUARY 1983												
41																			
42		Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Av	VAR	S.D.	C.V.
43																			
44	Plantain	4.70	4.92	4.12	3.36	3.36	4.90	6.12	7.01	9.16	8.02	7.19	6.57	12				1.51	24.68%
45	Banana	4.90	3.54	2.51	2.91	3.58	3.37	3.81	4.25	6.34	4.85	4.31	4.19	12				1.02	25.16%
46	Pepper	67.30	57.95	26.83	11.34	7.74	8.49	11.08	17.62	34.22	25.50	26.23	49.97	12				20.07	69.95%
47	Egg plant	9.70	12.50	12.22	6.47	6.31	8.54	10.91	7.78	12.43	8.44	9.83	9.56	12				2.16	22.63%
48	Bitterbal	24.40	13.44	12.60	8.10	6.48	9.31	8.64	8.89	8.96	11.54	11.39	24.29	12				5.95	48.24%
49	Okra	36.00	19.90	24.21	9.17	9.29	6.37	8.78	9.12	16.90	8.71	10.39	16.26	12				11.31	69.57%
50	Cassava	3.50	3.29	2.66	2.54	3.59	3.59	3.70	3.50	3.06	3.06	2.85	2.60	12				0.42	13.40%
51	Palm Nuts	4.60	4.43	3.63	3.53	5.01	5.28	6.33	5.14	8.76	6.65	7.43	5.45	12				1.54	27.91%
52	Palm Oil	52.43	35.14	40.54	40.55	45.00	53.72	56.28	52.70	59.66	51.89	50.69	[illegible]	12				7.29	14.81%
53																			
54	Wt. Average													12				2.63	30.83%
55																			
56																			
57																			
58							TRANSPORT COST (cents per pound)												
59							FEB 1982-JAN 1983												
60																			
61		Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Av	VAR	S.D.	C.V.
62																			
63	Plantain	2.30	2.30	1.93	2.39	2.04	1.35	1.54	2.03	2.53	2.72	2.55	2.10	12					
64	Banana	2.30	2.02	1.32	1.24	1.38	1.12	1.27	1.44	1.94	1.70	1.66	1.38	12					
65	Pepper	4.10	3.97	3.81	3.50	3.49	4.43	3.86	5.03	4.16	3.43	2.92	3.69	12					
66	Egg plant	2.30	5.00	2.64	2.54	3.63	3.40	3.60	3.00	2.89	3.33	2.67	3.19	12					
67	Bitterbal	2.30	2.60	2.44	2.44	2.84	3.36	2.85	3.51	3.16	3.16	2.24	2.77	12					
68	Okra	2.80	2.67	2.36	3.37	5.64	4.15	3.68	5.24	4.24	4.62	2.26	3.73	12					
69	Cassava	1.40	1.54	1.42	1.24	1.77	1.40	1.41	1.59	1.58	1.22	1.41	1.61	12					
70	Palm Nuts	1.70	1.03	1.99	1.66	1.84	1.98	1.64	1.91	1.81	2.00	1.79	1.80	12					
71	Palm Oil	5.74	4.38	4.50	4.34	6.78	5.29	4.80	5.70	6.62	4.55	4.05	3.42	12					
72																			
73	Wt. Average													12					
74																			
75																			
76																			
77							WHOLESALE MARGINS (cents per pound)												
78							FEB 1982-JAN 1983												
79																			
80		Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Av	VAR	S.D.	C.V.
81																			
82	Plantain													12					
83	Banana													12					
84	Pepper													12					
85	Egg plant													12					
86	Bitterball													12					
87	Okra													12					
88	Cassava													12					
89	Palm Nuts													12					
90	Palm Oil													12					
91																			
92	Wt. Average													12					
93																			

Figure 5.1. MPRICE.WK1 Spreadsheet With Market Survey Data

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WATERSIDE MARKET, MONROVIA
MONTHLY QUANTITIES IN POUNDS FEB 1982 JAN 1983

	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	total
Plantain	37,338	24,618	42,061	9,975	25,745	24,583	28,156	19,963	15,032	27,224	20,164	24,713	238,589
Banana	14,707	24,020	69,907	40,753	47,354	50,076	37,433	43,458	29,272	46,110	44,520	47,033	494,245
Pepper	2,615	11,157	13,500	20,175	30,256	31,746	33,975	15,957	12,670	[illegible],480	11,515	5,795	195,841
Egg plant	2,280	400	6,655	5,170	6,600	11,095	2,640	1,670	3,673	2,250	3,135	4,142	49,710
Bitterball	45,799	26,268	41,880	25,320	36,780	63,120	44,280	29,526	15,240	7,140	11,840	7,048	354,241
Okra	3,908	2,382	1,925	5,280	14,740	28,315	11,880	12,818	9,613	5,610	13,480	9,995	119,946
Cassava	34,306	60,527	81,855	36,460	57,885	90,990	54,300	50,523	22,140	11,600	48,060	37,334	585,982
Palm Nuts	12,960	9,213	16,560	8,650	14,490	5,120	31,120	23,195	8,003	3,640	13,950	13,057	159,958
Palm Oil	3,663	4,921	555	814	3,589	7,511	6,771	3,996	6,623	3,256	1,850	3,663	47,212
TOTAL	157,593	163,506	274,498	152,599	237,439	312,556	250,555	201,108	122,266	113,310	168,514	152,780	2,306,724

MONROVIA WHOLESALE PRICE (cents per pound)
WATERSIDE MARKET FEB 1982-JAN 1983

	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Avg	VAR	S.D.	C.V.
Plantain	12.20	15.87	12.32	16.75	15.07	11.30	14.11	13.95	14.80	15.75	15.89	14.44	12	14.02	14.37	2.83	1.69	11.75%
Banana	11.50	11.48	10.10	10.10	10.06	9.02	10.57	10.03	11.21	10.76	11.10	11.31	12	10.46	10.60	0.58	0.76	7.17%
Pepper	107.90	89.83	69.01	27.63	16.77	17.90	22.11	29.19	53.66	42.35	56.12	68.97	12	36.08	50.12	874.11	29.57	58.99%
Egg plant	21.00	22.50	23.96	10.07	13.32	15.52	20.11	14.97	20.80	17.33	18.05	17.97	12	17.16	17.97	16.15	4.02	22.37%
Bitterball	39.20	24.83	23.60	14.10	13.36	13.66	15.88	14.42	24.20	19.75	22.68	36.79	12	20.66	21.87	76.08	8.72	39.88%
Okra	64.60	55.39	42.49	18.90	23.93	13.45	16.44	18.90	28.84	18.60	16.21	28.89	12	21.89	28.89	276.97	16.64	57.61%
Cassava	6.50	7.92	6.18	6.24	6.78	6.72	6.52	6.64	6.27	5.39	5.65	5.[illegible]	12	6.51	6.37	0.44	0.66	10.39%
Palm Nuts	13.00	9.51	8.43	8.32	10.60	11.67	11.75	10.40	15.31	12.42	14.49	10.[illegible]	12	11.25	11.40	4.77	2.18	19.16%
Palm Oil	79.46	55.88	54.05	54.05	63.22	65.37	68.84	69.46	78.07	67.57	33.78	68.38	12	66.76	63.18	153.97	12.41	19.64%
Wt. Average	23.38	20.21	14.78	13.03	12.96	12.40	14.69	13.56	22.34	15.99	15.08	16.46	12	14.01	16.24	13.91	3.73	22.96%

MONTHLY FARMGATE PRICE (cents/pound)
FEBUARY 1982-JANUARY 1983

	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Avg	VAR	S.D.	C.V.
Plantain	4.70	4.92	4.12	5.36	5.36	4.90	6.12	7.01	5.16	8.02	7.19	6.57	12	5.87	6.12	2.28	1.51	24.68%
Banana	4.90	3.54	2.51	2.91	3.58	3.37	3.81	4.25	6.34	4.05	4.31	4.19	12	3.87	4.05	1.04	1.02	25.16%
Pepper	67.30	57.95	26.83	11.34	7.74	2.49	11.08	17.62	34.22	25.50	26.23	49.97	12	19.23	28.69	402.78	20.07	69.95%
Egg plant	9.70	12.50	12.22	6.47	6.31	8.54	10.91	7.78	12.43	8.44	9.83	9.56	12	9.16	9.56	4.68	2.16	22.63%
Bitterball	24.40	13.44	12.60	8.10	6.48	9.31	8.64	8.89	8.96	11.54	11.39	24.29	12	11.85	12.34	35.42	5.95	48.24%
Okra	36.00	39.90	74.21	9.17	9.29	6.37	8.78	9.12	16.90	8.71	10.39	16.26	12	11.53	16.26	127.93	11.31	69.57%
Cassava	3.50	3.29	2.66	2.54	3.59	3.59	3.70	3.50	3.06	3.06	2.85	2.60	12	3.21	3.16	0.18	0.42	13.40%
Palm Nuts	4.60	4.43	3.63	3.53	5.01	5.28	6.33	5.14	8.76	4.65	7.43	5.45	12	5.48	5.52	2.37	1.54	27.91%
Palm Oil	52.43	35.14	40.54	40.55	45.00	53.72	56.28	52.70	59.66	51.89	50.69	51.89	12	51.37	49.21	53.13	7.29	14.81%
Wt. Average	13.17	10.51	6.07	5.53	5.90	6.97	7.93	7.48	13.37	8.70	7.59	9.04	12	8.09	8.52	6.90	2.63	30.83%

TRANSPORT COST (cents per pound)
FEB 1982-JAN 1983

	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Avg	VAR	S.D.	C.V.
Plantain	2.30	2.50	1.93	2.39	2.04	1.35	1.54	2.03	2.53	2.72	2.55	2.10	12	2.13	2.17	0.17	0.43	19.39%
Banana	2.30	2.02	1.32	1.24	1.38	1.12	1.27	1.44	1.94	1.70	1.66	1.38	12	1.48	1.56	0.13	0.36	23.21%
Pepper	4.10	3.97	3.81	3.50	3.49	4.43	3.86	5.03	4.16	3.43	2.92	3.69	12	3.90	3.87	0.29	0.54	13.99%
Egg plant	2.30	5.00	2.64	2.54	3.63	3.48	3.60	3.00	2.89	3.33	2.67	3.19	12	3.11	3.19	0.51	0.72	22.48%
Bitterball	2.30	2.60	2.44	2.44	2.84	3.36	2.85	3.51	3.16	3.16	2.24	2.77	12	2.83	2.81	0.18	0.42	14.98%
Okra	2.80	2.67	2.36	3.37	5.64	4.15	3.68	5.24	4.24	4.62	2.26	3.73	12	4.05	3.73	1.21	1.10	29.50%
Cassava	1.40	1.54	1.42	1.24	1.77	1.40	1.41	1.58	1.58	1.22	1.41	1.61	12	1.48	1.47	0.02	0.16	10.76%
Palm Nuts	1.70	1.03	1.99	1.66	1.84	1.93	1.64	1.91	1.81	2.00	1.79	1.80	12	1.76	1.76	0.07	0.26	14.85%
Palm Oil	5.74	4.38	4.50	4.34	6.78	5.29	4.80	5.70	6.62	4.55	4.05	5.42	12	5.38	5.18	0.81	0.90	17.38%
Wt. Average	2.18	2.17	1.82	1.97	2.48	2.48	2.24	2.52	2.78	2.36	1.93	2.04	12	2.24	2.25	0.08	0.28	12.68%

WHOLESALE MARGINS (cents per pound)
FEB 1982-JAN 1983

	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	N	Wt Avg	Sim Avg	VAR	S.D.	C.V.
Plantain	5.20	8.45	6.27	9.00	7.67	5.03	6.45	4.91	3.11	5.01	6.15	5.77	12	6.03	6.09	2.74	1.65	27.18%
Banana	4.30	5.92	6.27	5.95	5.10	4.53	5.49	4.34	2.93	4.21	5.13	5.74	12	5.11	4.99	0.93	0.96	19.32%
Pepper	36.50	27.91	38.37	12.79	5.54	4.98	7.17	6.56	15.28	13.42	26.97	15.31	12	12.95	17.57	142.70	11.95	68.01%
Egg plant	9.03	5.00	9.10	1.06	3.38	3.50	5.60	4.19	5.48	5.56	3.55	5.22	12	4.89	5.22	4.96	2.23	42.66%
Bitterball	12.50	8.79	8.56	3.56	4.04	0.99	4.39	2.02	12.08	5.05	9.05	9.73	12	5.96	6.73	14.96	3.87	57.48%
Okra	25.80	12.82	15.92	6.36	9.00	2.93	3.98	4.54	7.70	5.27	3.56	8.90	12	6.31	8.90	43.52	6.60	74.14%
Cassava	1.60	3.09	2.10	2.46	1.42	1.73	1.41	1.56	1.63	1.11	1.39	1.47	12	1.82	1.75	0.30	0.55	31.52%
Palm Nuts	6.70	4.05	2.81	3.13	3.75	4.41	3.78	3.35	4.74	3.77	5.27	3.61	12	4.02	4.11	1.13	1.06	25.78%
Palm Oil	21.29	16.36	9.01	9.16	11.44	6.36	7.76	11.06	11.79	11.13	-20.96	11.07	12	10.01	8.79	103.42	10.17	115.71%
Wt. Average	8.04	7.52	6.89	5.53	4.50	2.95	4.53	3.56	6.19	4.93	5.56	5.39	12	3.68	5.47	2.30	1.52	27.73%

Figure 5.2 Completed MPRICE Spreadsheet for Market Survey.

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where Pi and Wi are respectively the prices and weight of the i-th commodities. Here we use quantities as weights. Thus the appropriate formula for Cell B35 is:

(B25*B$6+B26*B$7+B27*B$8+B28*B$9+B29*B$10+B30*B$11+B31*B$12+B32*B$13+B33*B$14)/B$16

Before you enter the formula, first make sure you understand why this formula would indeed give you a weighted average. Note that we have used the dollar sign to fixed the references to the quantities. Further note that we have only fixed the row reference but not column reference. The reason for this will be clear as we use the /Copy command to copy this formula to other locations in the worksheet. ***Enter the formula now.***

Then ***use the /Copy command to copy the formula in Cell B35 to C35.M35.***

(3.2) Calculate Weighted averages of data stored by rows.

Move to Cell O25. This is the cell for the weighted average annual price of Plantains. The weights used are again the quantities sold. Thus the appropriate formula for this cell is:

(B25*B6+C25*C6+D25*D6+E25*E6+F25*F6+G25*G6+H25*H6+I25*I6+J25*J6+

K25*K6+L25*L6+M25*M6)/N6

Enter the formula now.

Move to Cell P25. We will also calculate a simple average of the price for the year. ***Enter the formula in cell P25*** to calculate the simple average,

@avg(B25.M25)

(3.3) Using the Lotus Formulas for Variance and Standard Deviation.

Move to Cell Q25. This should contain the sample variance. The formula for the sample variance is:

$$\frac{\sum i \ (Pi - P)^2}{n - 1}$$

Sometimes, n instead n-1 is used as the divisor, but n-1 is more common. LOTUS provides a function called @var for computation of the variance. However, the @var function in LOTUS uses n instead of n-1 as the divisor. To adjust the LOTUS variance to an n-1 divisor, we multiply the LOTUS variance by n and divide by n-1. Thus the appropriate formula to ***enter in cell Q25*** is:

@var(B25.M25)*N25/(N25-1)

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where N25 contains the number of observations in the year, i.e. 12.

Move to Cell R25. This is the standard deviation of the prices for the year. The standard deviation is the square root of the variance. LOTUS provides the @sqrt function for computation of square root. The appropriate formula for this cell is:

@sqrt(Q25)

Enter this now.

Move to Cell S25. We will now calculate the coefficient of variation which is the ratio of the standard deviation and the simple average, expressed as a percentage. Since this cell has been formatted to display in percentage, only the formula of a ratio need be specified:

R25/P25

Enter in this formula now.

Now copy the formulas of Cells O25.S25 to the range O26.S33 using the /Copy command.

The formulas in the range O35.S35 should be copied from O33.S33 with the /Copy command, do it now.

4. Use the Copy Command to Replicate Large Blocks of Formulas

(4.1) We have thus finished the table for the WHOLESALE PRICE. We shall now tackle the FARMGATE PRICE table. We shall try to be as lazy as possible, letting the computer do the hard work. We have already cleverly used the /Copy command to fill in many formulas that are tedious to type in. We shall continue the same strategy with the other tables.

Now copy the formulas from B35.M35 to B54.M54.

You should now realize why we used the $ signs to keep the row reference to the quantities as we entered the formula for Cell B35. Otherwise the above /Copy operation would not have yielded the right answer. (why?).

(4.2) ***Copy the formulas from O25.S25 to O44.S44. Then move the cursor to Cell O44.*** The formula in this cell should be wrong, since the reference to the quantities (weights) in this formula are off. Use F2 (the Edit key) to correct this formula.

Then inspect the formulas in Cell P44, Q44, R44 and S44. Make sure you are convinced that these formulas did indeed copy correctly.

(4.3) ***Copy the formulas from O44.S44 to the rectangular area O45.S52.***

(4.4) Now to fill up the Cells O54 to S54, ***use the /Copy command to copy the formulas from O52.S52 to O54.S54.*** Now we have finished the FARMGATE PRICE table.

(4.5) The procedure to complete the TRANSPORT COST table is similar. First of all, use the /Copy command to ***copy the formula from B54.M54 to B73.M73.***

(4.6) Then ***copy the formula from O44.S44 to O63.S63.***

(4.7) (Sometimes it is easier to copy and correct a formula than to enter a new formula). ***The formula copied into Cell O63 is incorrect. Correct it using the F2 key.***

(4.8) After fixing Cell O63, ***use the /Copy command to copy O63.S63 to O64.S71.***

(4.9) Now complete the table. ***Use the /Copy command to copy O71.S71 to O73.S73.***

5. Calculation of Wholesale Margins

(5.1) Now we shall tackle the WHOLESALE MARGINS table. First ***position the cursor at cell B82.*** WHOLESALE MARGIN should be equal to WHOLESALE PRICE less FARMGATE PRICE less TRANSPORT COST. Thus the appropriate formula for this cell is:

+B25-B44-B63

Enter this in now.

(5.2) ***Using the /Copy command, copy Cell B82 to the rectangular area B82.M90.***

(5.3) Again using the /Copy command, ***copy B82 to the range B92.M92.***

(5.4) Use the Copy command to ***copy B82 to the range O82.O90.***

(5.5) Use the Copy command to ***copy P63.S63 to P82.S82.***

(5.6) Use the Copy command to ***copy P82.S82 to P83.S90.***

(5.7) Use the Copy command ***to copy O90.S90 to O92.S92.***

6. Save the Completed Worksheet

Now you have completed the worksheet, ***save this worksheet under the old name MPRICE with the /File Save command.***

II. DEVELOPING A GRAPHICAL ANALYSIS OF THE DATA

The purpose of this section is to show how the graphics commands in Lotus can be used to discover and present interrelationships in the data. The following tutorial discusses the development of a Stacked Bar Chart and a Pie Chart. The charts are fully enhanced to familiarize you with the optional features of the Graphics part of the Lotus Worksheet. Additional exercises are provided at the end of the lesson. Hopefully the graphical presentations demonstrated will spark your interest in continuing to develop graphs which dramatize the points you wish to make with your data.

1. Stacked Bar Chart: Suggested Procedure for GRAPH1

(1.1) First we develop GRAPH1 which is displayed as Figure 5.3. As seen in Figure 5.3, GRAPH3 is a stacked-bar chart. Each bar contains 3 components, namely, the Farm Gate Price, the Transportation Costs and Wholesale Margin. The total height of the bar represents Wholesale Price which is the sum of Farm Gate Price, Transportation Costs and Wholesale Margin.

Before we begin, ***Invoke /Graph Reset Graph*** to clear all existing graph settings.

(1.2) Now while still in the Graph menu, ***Invoke:***

Type Stacked-bar

to specify your desire for a stacked-bar graph.

(1.3) Now ***press X*** to define the X range. For stacked-bar graph, the X range values will appear as the labels for the X axis, in this case Feb, Mar, Apr, and so on. So go ahead and ***specify the range B23.M23 as the X range.***

(1.4) You should be returned again to the Graph menu. ***Press A*** to specify the A range. This should be the lowest stack of the stacked bar, in this case the Farmgate price for plantain. Thus ***the appropriate A range is B44.M44. Specify it!***

(1.5) Again at the Graph menu, ***Press B*** to specify the B range (the second data range). For a stacked-bar graph, this would be the next to the lowest stack of the stacked bar. In this case our B range should be the Transportation Cost for Plantain. So enter or ***select the range as B63.M63.***

(1.6) At the Graph menu, ***press C*** to specify the C range (the third data range). This would be the third stack of the stacked bar. Since we only have 3 stacks in this

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stacked-bar, this would be our top stack, or Wholesale margin. Enter in or ***select the range B82.M82.***

(1.7) Now ***choose View*** from the Graph menu to view the graph. The graph should look similar to GRAPH1 in Figure 5.3 except for the labelling. Press any key to return from viewing the graph back to the Graph menu. We will now enhance or beautify our Graph.

(1.8) Most of this enhancement will be done in the Option submenu of the Graph menu. So while at the Graph menu, ***choose Option*** to enter the Option submenu.

(1.9) We will first fix the titles. While in the Graph Option submenu, ***choose:***

Title First

and then ***enter:***

MONROVIA WHOLESALE PRICE

This will appear as the first title line of the graph.

(1.10) For the second line of the title. ***Choose:***

Title Second

while in the Graph Option submenu. Then ***enter:***

Waterside Market Feb 82-Jan83

This will appear as the second title line of the graph.

(1.11) To specify the X axis title, ***choose:***

Title X-axis

while in the Graph Option submenu. Then ***enter:***

Plantain

This title will appear below the X-axis.

(1.12) Similarly, to specify the Y axis title, ***choose:***

Title Y-axis

while in the Graph Option submenu. Then ***enter:***

Cents per pound

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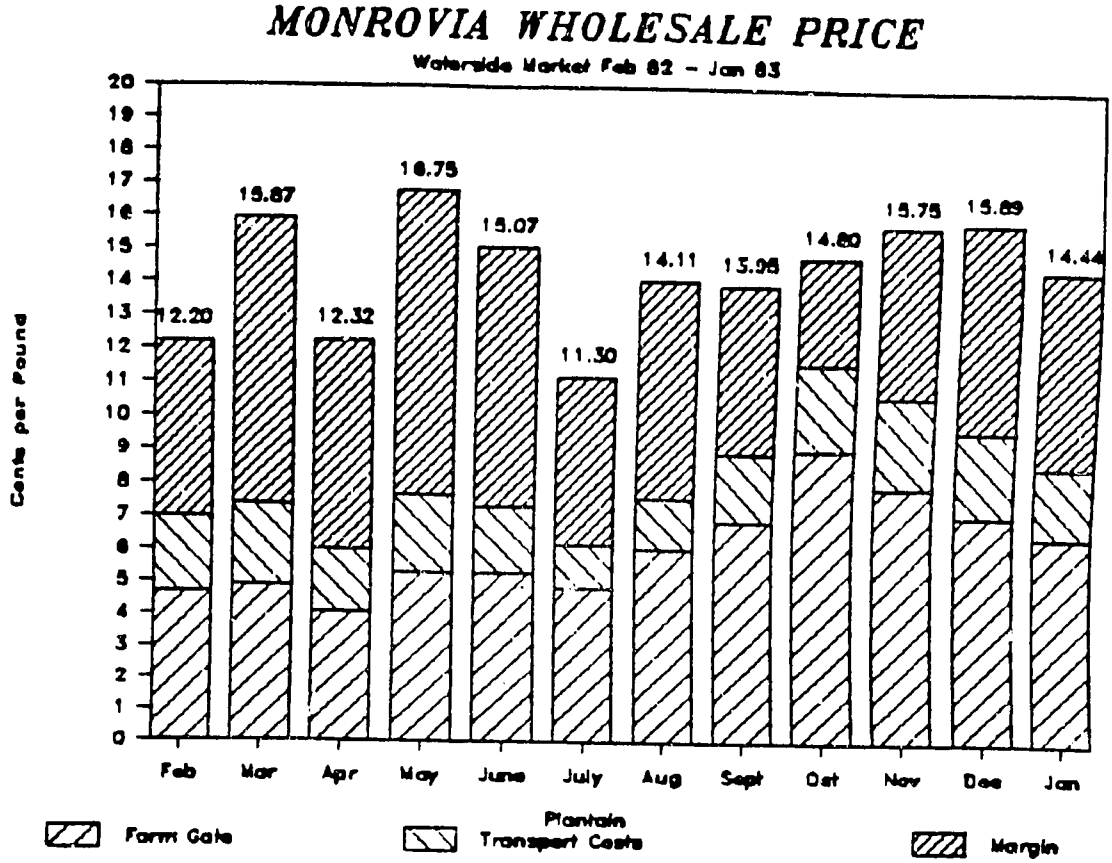

Figure 5.3. Stacked Bar Chart Showing Monthly Wholesale Prices and Marketing Margins for Plantain.

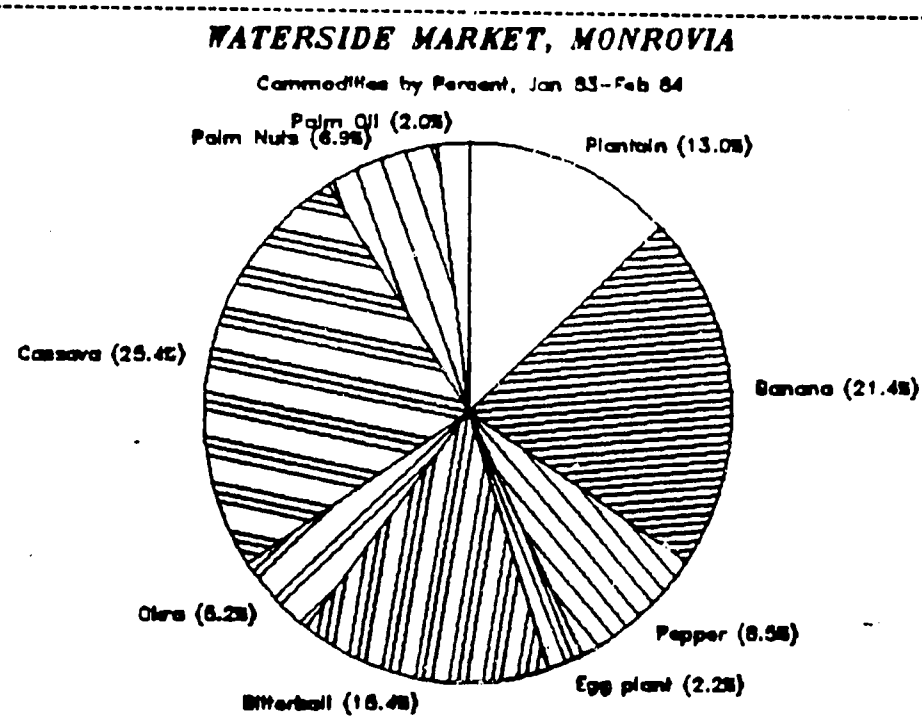

Figure 5.4. Pie Chart Showing the Annual Quantity and Relative Share (by Weight) of each Commodity Marketed.

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(1.13) Now ***choose Quit*** to exit the Graph Option submenu to return to the Graph menu. Choose View to view the graph. Compare the graph on the screen with Figure 3 and see what is missing. First of all we are missing the legends at the bottom of the graph. Second, we are missing the numbers at the top of the bar.

(1.14) To get the legend, ***choose Option*** from the graph menu. ***Then choose:***

Legend A

while in the Graph Option submenu. When prompted for the legend, ***enter:***

Farm Gate

as the legend for the A-range.

(1.15) Similarly, ***choose:***

Legend B

and then ***enter:***

Transport Costs

as the legend for the B-range.

(1.16) Now ***choose:***

Legend C

and then ***enter:***

Margin

as the legend for the C-range.

(1.17) To get the numbers on the top of the bar, ***choose***

Data-labels C

from the Graph Option submenu, then ***enter:***

B25.M25

LOTUS will then ask whether you would like to put the Data-Labels Center, Left, Right, Above, or Below the Bar. ***You should choose Above*** since you would like the numbers to appear ABOVE the bar.

Note that we have used the Data-labels for the C range, not the A range or the B range. This is because we want the Data-labels to appear above the C range, NOT the A

range or the B range. We used the WHOLESALE PRICE as the Data-labels because the total length of the bar is the WHOLESALE PRICE and NOT the MARGIN.

After specifying the Data labels, quit the Data-label submenu by ***pressing Quit. Then press Quit again*** to return the the Graph menu.

Now ***press View*** to view the graph, your graph should now look like the one in Figure 5.3.

(1.18) ***Save the current*** graph and settings in the computer memory ***by selecting:***

Name Create

then ***enter in the name GRAPH1***. (Recall the name option does not save the graph on the disk as a .PIC file).

(1.19) Save the worksheet under the old name MPRICE using the /File Save command.

2. PIE CHART: Suggested Procedure for GRAPH2

(2.1) Since you have just finished GRAPH1, the GRAPH1 settings are still remembered by LOTUS. To make LOTUS forget the old setting, ***invoke:***

/Graph Reset Graph

However we can restore the settings for GRAPH1 any time by the / Graph Name Use GRAPH1 command since we have saved GRAPH1 using the / Graph Name Save command.

(2.2) Now we are ready to start afresh on GRAPH2. GRAPH2 is a pie chart, thus ***specify a pie chart by selecting:***

Type Pie

in the Graph menu.

(2.3) ***Specify the A range by pressing A, then enter:***

N6.N14

as the A range. This is the total annual quantities for the 8 given commodities.

(2.4) ***Specify the X range by pressing X then enter:***

A6.A14

as the X range.

(2.5) Now we shall enter the title, to do so ***select:***

Option Title First

then ***enter in:***

WATERSIDE MARKET, MONROVIA

as the first title line. To enter in the second line of the title, ***select***

Title Second

then ***enter in:***

Commodities by Percent, Jan 83-Feb 84

Now press Quit to quit the Option submenu and return to the Graph menu.

(2.6) Now ***press View*** to view the graph, you should see a graph similar to the GRAPH2 in Figure 5.4. The only difference is the (lack of) shading of the slices.

(2.7) Shading the Pie. For LOTUS pie charts, the B data range is used to specify the shading of the pie. ***To illustrate: Insert a 0 in Cell O6, 1 in Cell O7, 2 in cell O8 and so on until 8 in Cell O14.*** The 0 to 8 are the number of the shading scheme LOTUS uses.

(2.8) ***Then choose B to specify the second "data range".*** Note that this is not really a "data range" per se but a shading scheme. But anyway ***enter:***

N6.N14

as the B data range. Then ***press View to view the graph.*** You graph should now be similar to GRAPH2 in Figure 5.4.

(9) Save the graph settings (in computer memory) by ***entering:***

Name Create

at the Graph submenu, ***use GRAPH2 as the name. Then save the entire worksheet under the old name MPRICE using the /File Save command.***

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EXERCISE

Use the methods described above to produce the other graphs shown in Figures 5.5 through 5.10. Don't forget to use /Graph Name Create to save the graph settings each time. After you finished, save the worksheet under the old name MPRICE using the /File Save command.

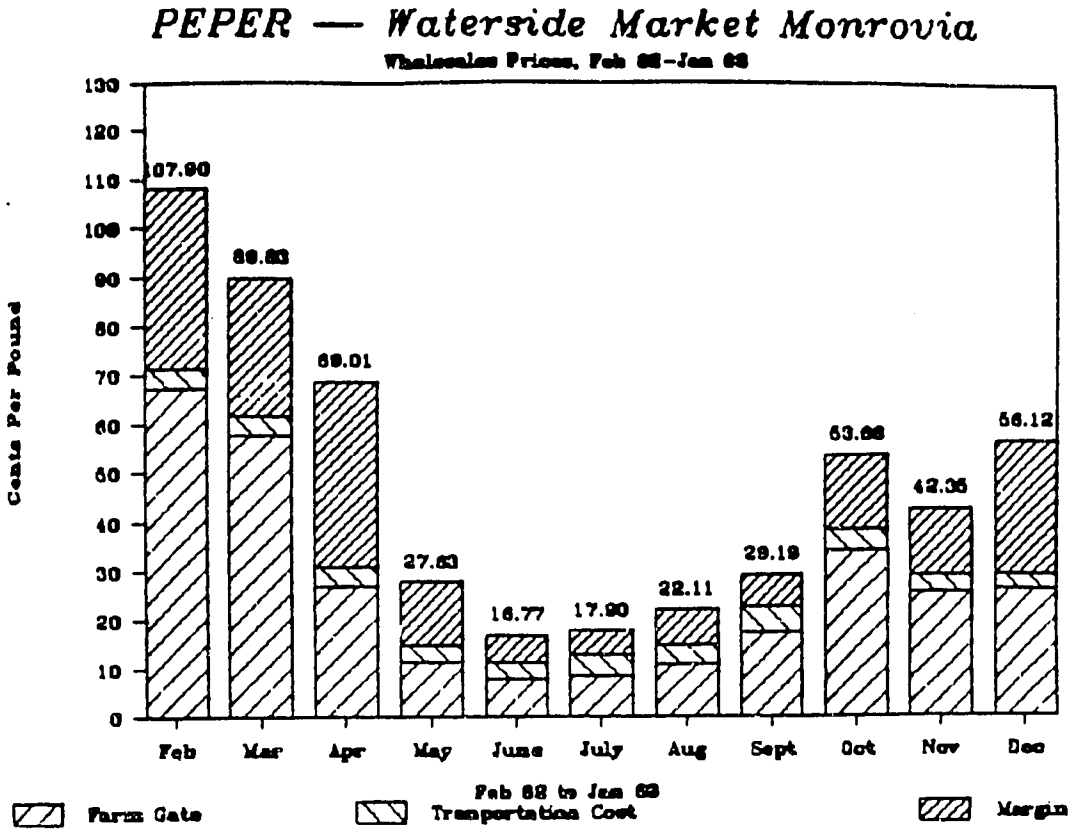

Figure 5.5. Stacked Bar Chart Showing Average Monthly Wholesale Prices and Margins for Pepper.

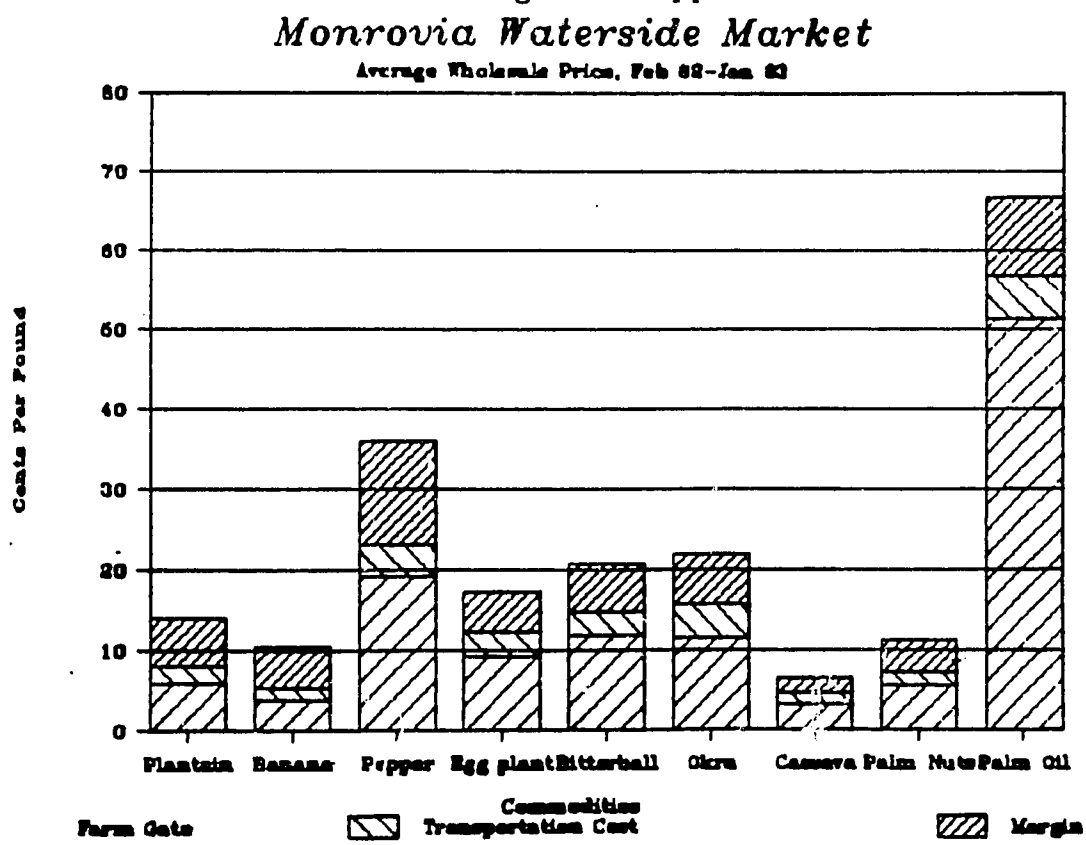

Figure 5.6. Stacked Bar Chart Using Horizontal Lines to Show Average Annual Wholesale Prices.

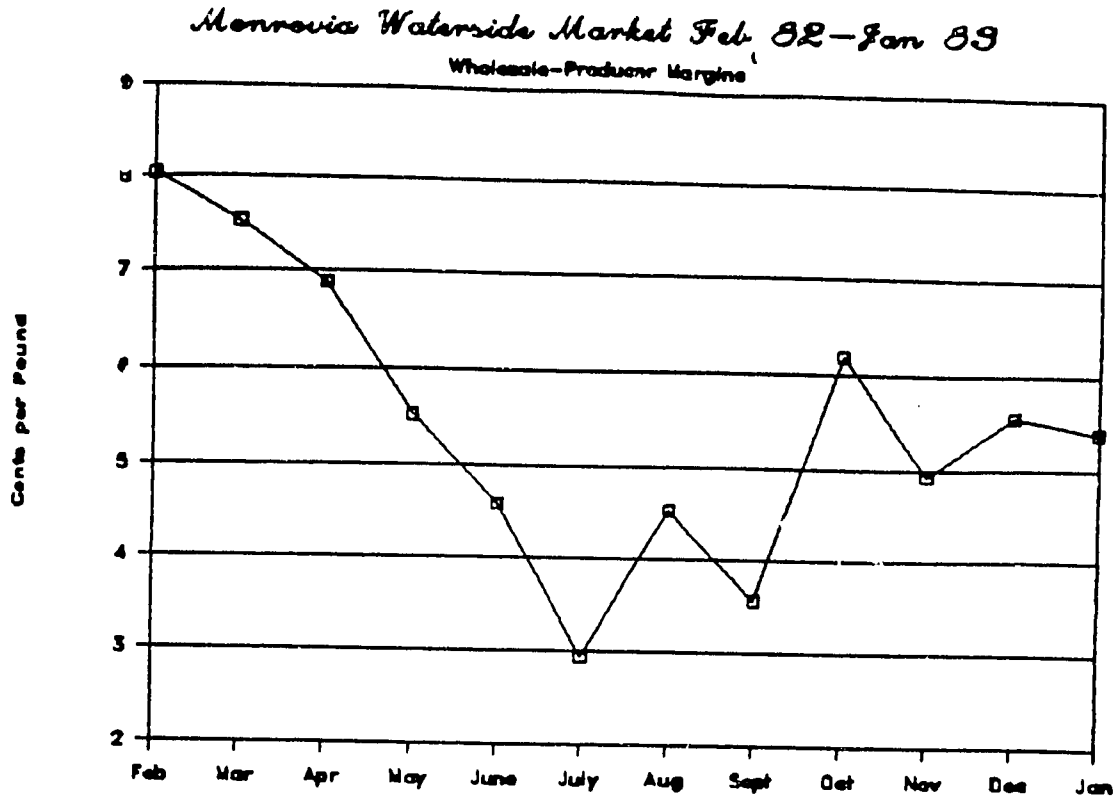

Figure 5.7. Line Chart and Horizontal Lines Used to Illustrate Monthly Changes in the Wholesale-Producer Margin.

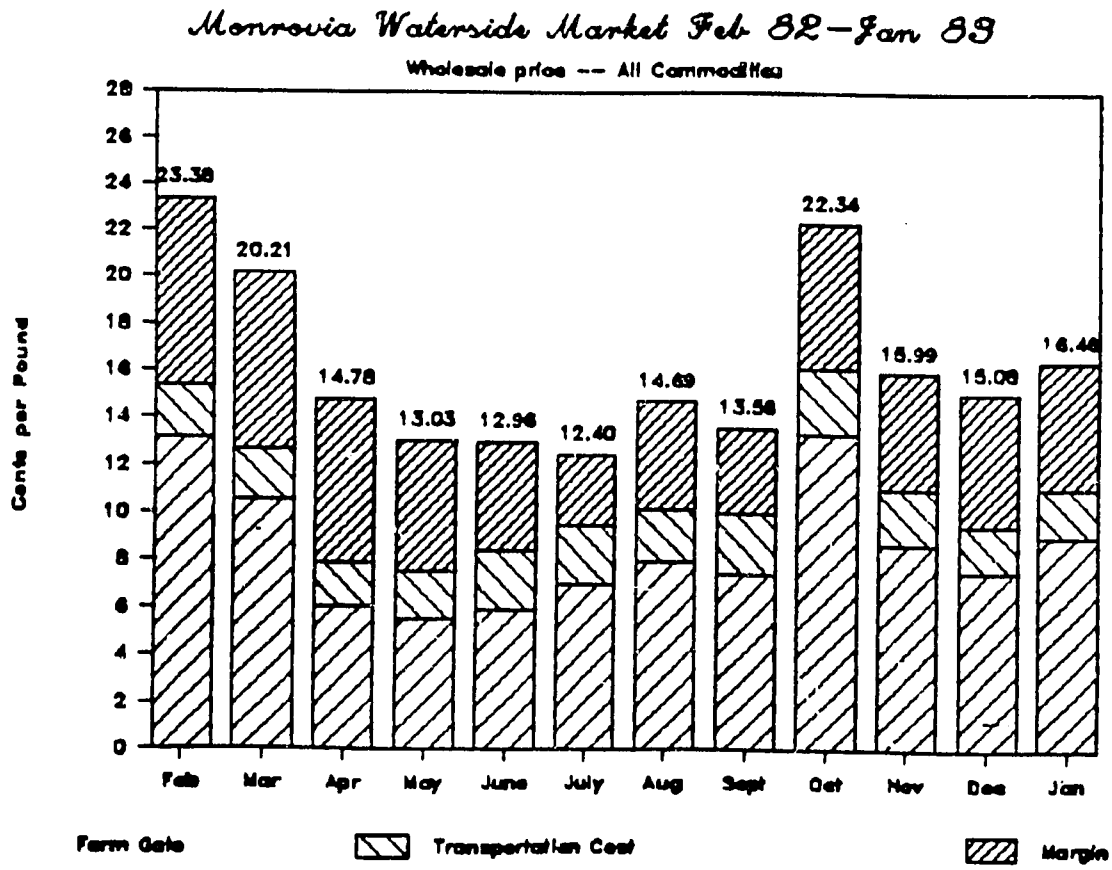

Figure 5.8. Stacked Bar Chart Used to Present Average Monthly Wholesale Prices for All Commodities.

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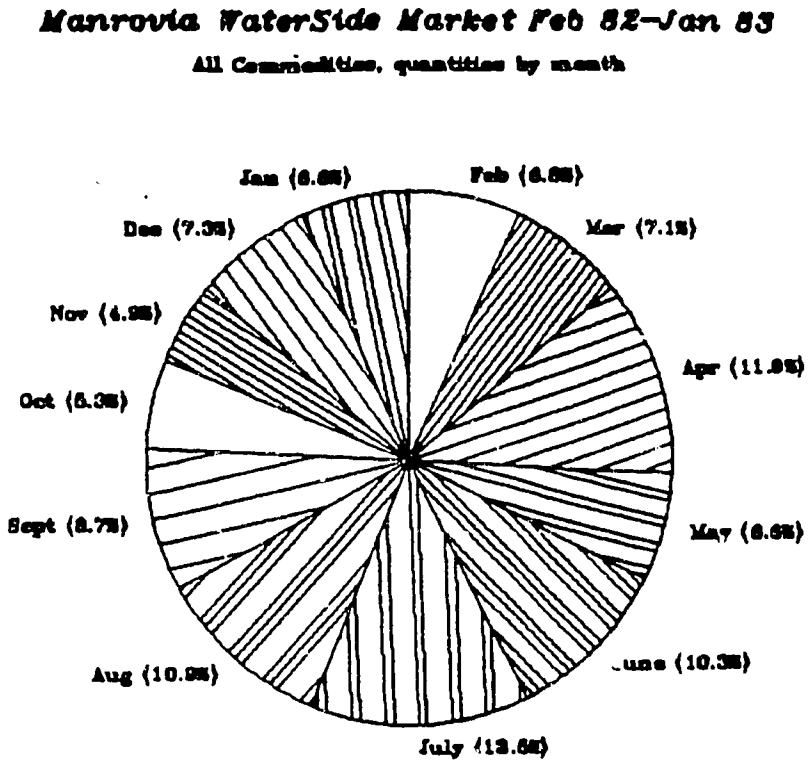

Figure 5.9. Pie Chart Used to Present Relative Monthly Quantities of all Commodities.

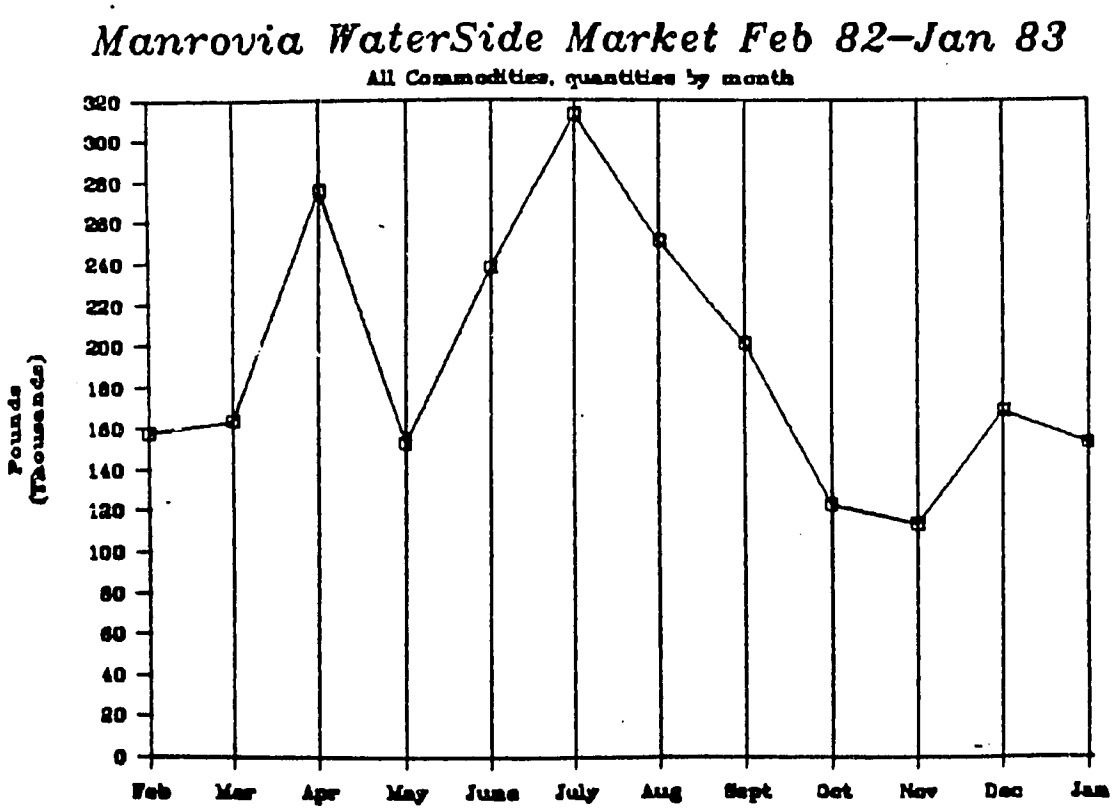

Figure 5.10. Line Chart with Verticle Lines Used to Present Monthly Quarters Marketed.

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Review of Skills

DESIGN A WORKSHEET TO REPORT RICE SALES

I

The accompanying table summarizes sales and shipment of the three estates of the Government Rice Marketing Agency of a certain African Country. Each estate buys rice locally and either sells the rice locally or ships to headquarters (HQ). The figures in the table are in terms of 100 lb bag paddy rice.

You are to design a LOTUS template similar to the accompanying table. In designing the template, the following points should be observed:

1. Your worksheet should be well formatted and layout. Use the /Range Format command and the /Worksheet Column Set-width command appropriately. Use your imagination and creativity to come up with a worksheet that is "nice" enough to go into an official report.

2. All totals and percentages must be calculated with formulas.

3. If you don't use the /Copy command smartly, it will take you forever to complete this worksheet. Plan ahead and think how the /Copy command can save your time and effort.

4. Save the worksheet under the name EX1.

II

Suppose you are to present the information in this worksheet to your boss the Honorable Minister V. Busy. Mr. Busy only has time to look at 3 graphs (that's why we call him Busy). Design 3 LOTUS graphs which you think will best summarize the information of the table for your minister. Use your imagination and creativity!

NOTE: Since this is a review of skills we have already covered, the lab instructors reserve the right to not answer some of your questions.

Sales and Shipment of Rice Marketing Agency Estates for Jan-Dec 1984

Estate		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gbarnga	Sales	1703	1798	1233	2765	1847	4038	4088	4345	2200	4015	1532	1020	30584
	Shipment to HQ	2100	2275	0	0	0	150	0	0	0	0	0	200	4725
	Total	3803	4073	1233	2765	1847	4188	4088	4345	2200	4015	1532	1220	35309
	% Sales	44.8	44.1	100.0	100.0	100.0	96.4	100.0	100.0	100.0	100.0	100.0	83.6	86.6
	% Shipment	55.2	55.9	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	16.4	13.4
Ganta	Sales	185	150	273	154	1059	708	1718	1635	618	637	189	108	7434
	Shipment to HQ	0	0	0	0	610	558	328	270	246	186	0	80	2278
	Total	185	150	273	154	1669	1266	2046	1905	864	823	189	188	9712
	% Sales	100.0	100.0	100.0	100.0	63.5	55.9	84.0	85.8	71.5	77.4	100.0	57.4	76.5
	% Shipment	0.0	0.0	0.0	0.0	36.5	44.1	16.0	14.2	28.5	22.6	0.0	42.6	23.5
Voinjama	Sales	185	145	1233	335	233	333	223	1345	711	345	456	783	6328
	Shipment to HQ	1390	1810	840	480	640	2040	326	659	573	250	179	0	9287
	Total	1575	1955	2073	815	873	2373	549	2004	1385	595	635	783	15615
	% Sales	11.7	7.4	59.5	41.1	26.7	14.0	40.6	67.1	51.4	58.0	71.8	100.0	40.5
	% Shipment	88.3	92.6	40.5	58.9	73.3	86.0	59.4	32.9	48.6	42.0	28.2	0.0	59.5
Total	Sales	2073	2093	2739	3254	3139	5079	6029	7325	3530	4997	2177	1911	44346
	Shipment to HQ	3490	4085	840	480	1250	2748	654	929	919	436	179	280	16290
	Grand Total	5563	6178	3579	3734	4389	7827	6683	8254	4449	5433	2356	2191	60636
	% Sales	37.3	33.9	76.5	87.1	71.5	64.9	90.2	88.7	79.3	92.0	92.4	87.2	73.1
	% Shipment	62.7	66.1	23.5	12.9	28.5	35.1	9.8	11.3	20.7	8.0	7.6	12.8	26.9

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Lesson 6

ENTERPRISE BUDGET PREPARATION

TUTORIAL

Prepared by Darrel Kletke

The following exercise is designed to familiarize you with procedures for preparing an enterprise budget on a micro computer spreadsheet. The specific objectives are:

- Increase your proficiency with Lotus 1-2-3.
- Become familiar with principles for preparing enterprise budgets.
- Become acquainted with characteristics of spreadsheets which make them desirable for preparing budgets.

The example that will be used was taken from budget information obtained from Zambia. Many of the machinery cost estimation procedures used in the budget chapter discussed earlier will not be appropriate. This exercise will consist of preparing three enterprise budgets. The first will be the hardest. It will require the most typing. Most of it will be entering data. Budgets 2 and 3 will be modifications of the first.

Because you have not had too much experience in working with spreadsheets, most of the steps will be given. As the steps are repeated later in the exercise, the detail provided will be less. The first budget to be prepared is for maize on large scale commercial farms. You should begin by having a blank Lotus spreadsheet on the screen.

TITLE AND COLUMN HEADINGS

A1 — ***Type the title: Maize: Large Scale Commercial Farms***

A1 — To help format the budgets we want to set the column width to 4: The command is:

/ Worksheet Column Set-Width ***4***

A short way of doing this is to ***type: / W C S 4 ® (we will use ® to denote the return key.)***

B1 — ***Move the cursor to B1 and set the width of column B to 4 characters.***

C1, D1 — ***Repeat the above procedure and set the width of columns C and D to 4.***

E1 — ***Set the width of column E to 9***

F1, G1	***Set the width of columns F and G to 7.***
H1, I1, J1	***Set the width of columns H, I, and J to 11.***
H3	***Type the label: Price or***
G4	***Type the label: Unit***
H4	***Type the label: Cost/Unit***
I4	***Type the label: Quantity***
J4	***Type the label: Value***
A5	Put a line across the page. The easiest way of doing this is to ***type \ -***, then press return. This will fill cell A5 with a dashed line.
A5	Then copy the contents of cell A5 into cells B5 through J5. The command:

/ C ® B5.J5 ®

Production

A6	***Type the label: Production:***
B7	***Type the label: 90 kg bags***
G7	***Type the label: per ha***
H7	***Enter the price per unit of maize sold: 85***
I7	***Enter the bags of maize produced: 61.1***
J7	***At this point we want to begin using the computational power of the spreadsheet. The value produced is the price times quantity, or cell H7 times I7. To get this result enter:***

+H7 * I7 ®

D8	***Enter the label: Total***
J8	Because there is only one item, maize, being produced, the total will be the same value as in J7. ***Enter:***

+J7

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Operating Inputs

A10 ***Enter the label: Operating Inputs:***

B11-B25 ***Enter the rest of the labels***

	Col B	Col G
Row 11	***Seed***	***kg.***
Row 12	***Fertilizer: D Mixture***	***kg.***
Row 13	***Fertilizer: Urea***	***kg.***
Row 14	***Fertilizer: Lime***	***kg.***
Row 15	***Chemicals: Herbicides***	***ha.***
Row 16	***Chemicals: Insecticides***	***ha.***
Row 17	***Labour***	***days***
Row 18	***Bags***	***count***
Row 19	***Fuel, +20% oil & lube***	***l.***
Row 20	***Machinery repairs***	***ha.***
Row 21	***Building repairs***	***ha.***
Row 22	***Insurance***	***ha.***
Row 23	***Hauling***	***ha.***
Row 24	***Other expenses***	***ha.***
Row 25	***Interest (9 months)***	***ha.***

D26 ***Enter the label: Total Operating Costs***

H11 - I17 ***Enter the prices and quantities*** for most of the operating inputs.

	Col H	Col I
Row 11	***4.8***	***25.2***
Row 12	***1.6***	***392***
Row 13	***1.26***	***297***
Row 14	***.3***	***100***
Row 15	***183.71***	***1***
Row 16	***120.20***	***1***
Row 17	***6.5***	***56***

H18 ***Enter the price of each bag purchased: .5***

I18 One bag will be needed for each 90 kg of production. So that we don't have to change this number for each budget prepared, enter the following equation so the yield is inserted automatically.

+I7

H19 ***Enter the price of fuel in H19: 1.87***

I19 The fuel and lube cost is computed as the fuel cost plus 20% for lubricants. The amount of fuel used is 142 liters. Increase this by 20% to reflect the cost of lubricants:

142 + 142*.2

J20-J24

The entries for this range are computed on a per ha. basis. Thus, they are not broken into price and quantity.

J20	***575.33***
J21	***42***
J22	***33.45***
J23	***37.81***
J24	***42.87***

H25

The annual interest rate of 25% should be entered. ***This can be entered as either .25 or 25%.*** In either case, the result should appear as .25.

I25

The capital borrowed depends on the operating costs. As discussed earlier, we normally do not find it necessary to borrow to cover harvesting costs. In the list of operating input expenses, the major harvesting costs that can be separated out are bags and hauling. This means the amount we must borrow is the total of all costs less the bag cost and hauling cost. The formula for this is:

@SUM(J11.J24)-J18-J23

The @SUM is a function which sums all entries between J11 and J24.

J11

The entry is the price of seed times the quantity of seed purchased.

+H11*I11

J12-J19

These entries are computed just like the entry in J11. Therefore the easiest way to insert the equations is to use the COPY command.

First, ***put the cursor on cell J11.*** Then press the / . ***Choose the COPY*** command.

The next step is to enter the range we want to copy. In this case, we want to copy only one cell, so press return.

We now must indicate where we want to copy the cell too. ***Move the cursor to cell J12.*** This is the first cell we want to put the equation in. To mark this as the beginning, ***press "."***. Then ***move the cursor*** down ***to cell J19***. This is the last cell we want to put the equation in. At this point cells J12 through J19 should all be highlighted. To complete the command, ***press return.***

J25

The interest expense for one year is computed by multiplying the annual interest rate by the amount of annual capital. However, in this case the capital is borrowed for only 9 months. Therefore, the interest is 9/12 of the annual interest. To obtain this result, ***enter:***

+H25*I25*9/12

J26 This is the total operating cost and is the sum of all individual operating costs. Use the @SUM function.

@SUM(J11 . J25)

Fixed Costs

A28 ***Enter the label: Fixed Costs:***

B29 ***Enter the label: Machinery***

C30 ***Enter the label: Interest***

G30 ***Enter the label: ha.***

H30 ***Enter the interest rate: 8%***
It will show as .08

I30 ***Enter the average machinery investment: 3499.2***

J30 Multiply the interest rate by the average machinery investment.

+H30 * I30

C31 ***Enter the label: Depreciation***

G31 ***Enter the label: ha.***

J31 ***The the amount of machinery depreciation per year: 614***

B32 ***Enter the label: Buildings***

C33 ***Enter the label: Interest***

G33 ***Enter the label: ha.***

H33 ***Enter the interest rate: 8%***

I33 ***Enter the average investment in buildings/ha.: 600***

J33 ***Enter the equation for computing a change for interest on buildings:***

+H33 * I33

C34 ***Enter the label: Depreciation***

G34 ***Enter the label: ha.***

J34 ***Enter the building depreciation cost/ha.: 30***

B35 ***Enter the label: Land***

C36 ***Enter the label: Interest***

G36 ***Enter the label: ha.***

H36 ***Enter the interest rate: 8%***

I36 ***Enter the average investment in land: 600***

J36 ***Enter the equation to compute the annual interest on land:***

+H36*I36

D37 ***Enter the label: Total Fixed Costs***

J37 ***Enter the equation to compute total fixed costs:***

@SUM(J30 . J36)

Returns

A39 ***Enter the label: Returns above total operating costs***

J39 Returns above operating costs are computed by subtracting the total operating costs in cell J26 from the total receipts in cell J8.

+J8 - J26

A41 ***Enter the label: Returns above all costs except overhead, risk, and mgmt.***

J41 Returns above all costs except overhead, risk, and management are computed by subtracting the fixed costs in cell J37 from the returns above all operating costs in cell J39.

+J39 - J37

This is a good time to save the budget so if we make a mistake we won't lose everything. To do this enter:

/ F S

The prompt should now be asking for a name. We will be preparing several budgets. So they have unique names, call this one:

MAIZELF

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This will indicate that this budget is for maize on a Large Farm.

Sensitivity Analysis

A43 — Enter the label: ***Costs/bag by yields***

G43 - J44

G43	***"Yield***	(note the " right justifies the label)
H43	***"Variable***	
I43	***"Fixed***	
J43	***"Total***	
G44	***"(bags)***	
H44	***"Cost/bag***	
I44	***"Cost/bag***	
J44	***"Cost/bag***	

G46 — Skip G45 for the moment. In cell G46 we want the yield for the budget. This was first entered in cell I7. ***Insert the equation:***

+I7

G45 — In our sensitivity analysis the yield on the first line is 5 less than on line 46. To reflect this, ***enter the equation:***

+G46 - 5

G47 — ***Enter the equation:***

+G46 + 5

H45 — To express the variable cost on a per bag basis, divide the total variable cost in cell J26 by the number of bags in cell G45. We want to use the COPY command to fill in the next two rows. Therefore we must make the reference to cell J26 absolute. If we do not, the copied equation will use cell J26 for cell H45, cell J27 for cell H46, and cell J28 for cell H47. We want cell J26 for all three equations. ***Enter the following formula with the $ characters in the formula to make the reference absolute.***

+$J$26 / G45

I45 — To express fixed costs on a per bag basis, divide the total fixed costs in cell J37 by the number of bags in cell G45. ***Insert the $*** to make the reference to cell J37 absolute.

+$J$37 / G45

J45 — The total cost per bag in cell J45 is the sum of variable and fixed costs/bag.

+H45 + I45

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H46 - J47 The COPY command can be used to complete the sensitivity table.

Place the cursor on cell H45. ***Enter: / C***

Move the cursor cell J45. This should highlight cells H45, I45, and J45. ***Press return.***

Move the cursor to cell H46. Mark this as the beginning of the TO range by pressing: ".".

Move the cursor to cell J47. This should highlight the cells H46 through J47. ***Press return to complete the copy.***

IMPROVEMENTS FOR PRESENTATION

We have all the information needed for the budget. However, it is possible to make it look a little better. Following are some possibilities. You may have some additional ideas.

Home Press the Home key to return to the beginning of the budget.

H3 ***Move the cursor to cell H3.*** Our budget would look better if we right justified the column headings. To accomplish this, first press:

Then press ***"R"*** to indicate that we wish to work on a range of data.

Then press ***"L"*** to indicate that we are working on a label.

Then press ***"R"*** to indicate we want to right justify.

Move the cursor to cell J4. This will highlight the six cells to be affected.

Press return.

H7 Currently, none of the decimal points line up. The budget would look better if they did. With the cursor in cell H7, enter:

/ R F

This indicates we want to put a fixed format on a selected range of data.

The command line shows ***2 decimal places***. Since this is what we want ***press return.***

Now move the cursor to cell J47. The whole area should now be highlighted.

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Press return. All our our numbers should now have two decimal places.

A5

It might look better if we put an additional line at the bottom of the budget. The easiest way to do this is to copy the one in row 5. ***With the cursor in A5, enter:***

/ C

Move the cursor to cell J5. This should highlight cells A5 through J5. ***Press return.***

Press the PgDn key twice to get to the bottom of the budget. ***Move the cursor to cell A48. Press return.*** This should copy the line to that location.

H25

Currently the interest rates are stated as decimals. It would look better if they were in percentages.

With the cursor in cell H25, enter:

/ R F P

This indicates we want to work on a range of data, put a fixed format on it, and we want that format to be a percent.

We are now being asked how many characters to the right of the decimal point. ***Enter: 1. Press return.***

Now we need to indicate over what range we want to have percentages used. ***Move the cursor to cell H36.*** This should highlight the affected range. ***Press return.*** All numbers in the range H25 through H36 should now be stated in percentage terms.

We have completed the budget, so we should save it to file. This can be done by entering:

/ F S

At this point the name previously used should appear on the prompt line. ***If we want to use the same name, press return.***

Press R to indicate that you want to replace the file. This should result in the file being replaced.

ANOTHER BUDGET

One of the good features of a spreadsheet is that it can easily be modified to develop another budget. In this case, we want to build a budget for oxen technology. This part of the exercise will be used to learn ways of modifying the information.

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A1 The title can be most easily be modified by entering the whole name.

Maize: Oxen Technology

I The quantity of maize is changed to ***25.28.***

H11 The price of seed is ***2.75*** rather than 4.8 because of a quality difference.

I12 The quantity of Fertilizer: D Mixture is ***124.5***

I13 The quantity of Urea is ***120.***

I14 The quantity of lime is ***0***

H15 The value of herbicides per ha. is ***0***

H16 The value of insecticides per ha. is ***.77***

I17 The quantity of labor is ***104.8*** days

I18 This number changed when yield was changed.

B19 Because we use no fuel, ***change this name*** to:

Dipping of oxen

G19 Change to ***ha.***

H19 The oxen will be dipped one time per ha. ***1***

I19 The cost of each dipping is ***25.28***

J20 Machinery repairs change to ***36.63***

B21 Since we have no buildings but need to charge for a death loss on oxen, change this to:

Oxen death loss

H21 The rate of loss is ***8%.*** Use the ***/ R F*** command to change the entry to percent.

I21 The average value of the oxen is ***969***

J21 The cost is the percentage times ***969.*** To obtain this enter:

+H21 * I21

J22 Change insurance to ***33.45***

J23 Change hauling to ***26.71***

J24 Change other expenses to ***19.24***

The other operating expenses will be changed automatically. Note that the amount of annual capital in cell I25 has changed.

I30 The average machinery investment is ***1034***

J31 There is no depreciation. Enter ***0***

I33 There is no charge for buildings. Enter ***0***

J34 There is no depreciation. Enter ***0***

This should complete the changes required. All of the returns figures and the sensitivity numbers are changed automatically. Since we have completed this budget, it should be saved using the name:

maizeot

MORE PRACTICE

We can prepare another maize budget for small scale commercial farms. This budget is more like large scale farms than oxen farms, so it would be best to begin with the large scale farm budget. We want to retrieve the budget with the title "MAIZELF" Do this with:

/ F R MAIZELF ®

A1 We need to edit the title: ***Press the F2 key. Press the left arrow key (4) until the cursor is in the space between Large and Scale.*** Then press the backspace key until the Large is gone. Then type in: ***Small***

Change the amount of production to ***44.9***
Change the price of seed to ***4.3***.
Change the quantity of Fertilizer: D Mixture to ***337.6***
Change the quantity of Fertilizer: Urea to ***233.9***
Change the quantity of Lime to ***0***
Change the price of herbicides to ***16.40***
Change the price of insecticides to ***0***
Changes the days of labor to ***79***
Change the quantity of fuel to ***71***
Change machinery repairs to ***348.61***
Change the building repairs to ***23.4***
Change the insurance to ***12***
Change the hauling to ***11.51***
Change other expenses to ***30.63***
Change machinery average investment to ***4176***
Change the value of machinery depreciation to ***371.85***

Change the value of buildings to ***200***
Change the building depreciation to ***10***
This should complete the budget.

Save it as: ***MAIZESF***
This stands for maize small farm.

	A B C D E F	G	H	I	J
1	Maize: Large Scale Commercial Farms				
2					
3			Price or		
4		Unit	Cost/Unit	Quantity	Value
5	Production:				
6	90 kg bags	per ha	85.00	61.10	5193.50
7	Total				5193.50
8					
9	Operating Inputs:				
10	Seed	kg.	4.80	25.20	120.96
11	Fertilizer: D Mixture	kg.	1.60	392.00	627.20
12	Fertilizer: Urea	kg.	1.26	297.00	374.22
13	Fertilizer: Lime	kg.	0.30	100.00	30.00
14	Chemicals: Herbicides	ha.	183.71	1.00	183.71
15	Chemicals: Insecticides	ha.	120.20	1.00	120.20
16	Labour	days	6.50	56.00	364.00
17	Bags	ha.	0.50	61.10	30.55
18	Fuel, +20% oil & lube	l	1.87	170.40	318.65
19	Machinery repairs	ha.			575.33
20	Building repairs	ha.			42.00
21	Insurance	ha.			33.45
22	Hauling	ha.			37.81
23	Other expenses	ha.			42.87
24	Interest (9 months)	ha.	25%	2832.59	531.11
25	Total Operating Costs				3432.06
26			Cost/	Average	
27	Fixed Costs:		Unit	Investment	
28	Machinery				
29	Interest	ha.	8%	3499.20	279.94
30	Depreciation	ha.			614.00
31	Buildings				
32	Interest	ha.	8%	600.00	48.00
33	Depreciation	ha.			30.00
34	Land				
35	Interest		8%	600.00	48.00
36	Total Fixed Costs				1019.94
37					
38	Returns above total operating costs				1761.44
39					
40	Returns above all costs except overhead, risk, and management				741.51
41					
42	Costs/bag by yields	Yield			
43		Bags/ha	Variable/bag	Fixed/bag	Total/bag
44		56.10	61.18	18.18	79.36
45		61.10	56.17	16.69	72.86
46		66.10	51.92	15.43	67.35
47					
48					

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Lesson 7

AN INTRODUCTION TO LINEAR PROGRAMMING

A MUSAH Tutorial

Prepared by Francis Epplin

BACKGROUND

The microcomputer permits the researcher to use Linear Programming techniques to solve many kinds of resource allocation problems. While large scale linear programming problems are still best done with a mainframe computer, the software developed for microcomputers has become increasing powerful and sophisticated. The researcher using the microcomputers and related software available today is able to solve many problems which required large mainframe computers a few years ago. It can be expected that microcomputers and the related software will become increasingly powerful so that problems that are still difficult to solve today will be easier to handle in the future.

References

Epplin, F.M. and A. Stoecker. "Chapter 9, Mathematical Programming", in *Policy Analysis Tools for Economic Development*, L. Tweeten ed., Forthcoming, Oklahoma State University, 1988.

Li, E., D.E. Ray and A. Stoecker, "MUSAH86: A Linear Programming Package for Use with Lotus 1-2-3", APAP Report B-29, Oklahoma State University, April 1988.

Li, E., D.E. Ray and A. Stoecker, "ToMPS: A File Translation Utility for Converting LP Tableaus Coded in Lotus 1-2-3 to MPS Format". APAP Report B-28, Oklahoma State University, April 1988.

OBJECTIVES

The objective of this section is to provide the participant with an introduction to linear programming and with experience in solving linear programming problems on a microcomputer. It is not expected that participants who are unfamiliar with linear programming will become experts in the construction of linear programming models. However, the solution software and the initial instruction provided with this section can be used by the participants to gain additional experience with linear programming when used with other references.

This tutorial is to be used in conjunction with Chapter 9, Mathematical Programming by Epplin and Stoecker. The purpose of this tutorial is to provide a step by step procedure for solving linear programming problems with the MUSAH linear programming system. MUSAH is a program which accepts as input, a linear programming tableau which has been prepared with Lotus 1-2-3. and saved to a disk file. MUSAH (written by Dr. E. Li at OSU) is a linear programming routine which reads a Lotus file which contains the LP tableau, solves the linear programming problem and writes solution to the linear programming problem back into a Lotus 1-2-3 data file. To view the solution, the user returns to Lotus and retrieves the file containing the linear programming solution.

It is assumed the student:

1. Has a computer with two disk drives
2. Has a copy of Lotus, release 2 in Drive A:
3. Has a DOS formatted data disk in Drive B:
4. Has reviewed Chapter 9, "Mathematical Programming"

Steps for using the program are provided. The program is illustrated with example problems included in the Mathematical Programming Chapter (Chapter 9) in the reference book. The examples are used to illustrate input format requirements. In addition, output from the program is provided with interpretation of results.

STEPS FOR USING MUSAH86 TO SOLVE PROBLEM EX1

1. Enter the Problem in a Lotus Worksheet

Start up Lotus
a. ***Insert the Lotus program disk in Drive A:***
b. ***Put a formatted data disk in Drive B:***
c. Type ***Lotus***
d. Select ***1-2-3***, you should see a blank spreadsheet.

In the first exercise, you will be asked to type the data for Problem EX1 (from Chapter 9) into the spreadsheet as it appears below in Figure 7.1.

	A	B	C	D	E
1	EX1	MAXIMIZE	B	CORN133	SORGHUM
2	C			58.76	45.48
3	LAND	L	160	1	1
4	LABOD	L	600	1.68	0.66

Figure 7.1 Linear Programming Tableau for Problem EX1 in MUSAH Format.

1.1 Name the Problem.
Move the cursor to cell A1.
Type EX1 as the name of the problem. A problem name is just used to identify the problem. In this case EX1 stands for Example 1.

1.2 Enter the name of the objective function row.
Move the cursor to Cell A2
Type C as the name for the objective function. You could also use a name like OBJ or another name of 8 characters or less.

1.3 Enter the names of the rows or problem constraints in Column A starting in row 3.
Move the cursor to Cell A3. Type

LAND

The coefficient related to the supply and use of land will be entered in this row.
Move the cursor to Cell A4. Type

18

LABOD

This will be the row for the labor constraint.

1.4 Indicate whether this is a maximization or a minimization problem.
Move the cursor to Cell B1. Type

MAXIMIZE

The word maximize indicates this will be a maximization problem. For a minimization problem, you would type in the word MINIMIZE.

Leave cell B2 blank.

1.5 Indicating Row or Constraint Types.

Constraints in linear programming are designated as being either L, G, E, or N where

L designates a less than or equal constraint,
G designates a greater than or equal constraint,
E designates an equality constraint, and
N designates a nonconstraining row.

The system used here is consistent with the system used in well known routines such as MPSX, MINOS, or LINDO. For EX1 the amount of LAND used must be less than or equal to 160 units.
Move the Cursor to Cell C3. Type

L

The Labor constraint is entered next. The amount of labor used must be less than or equal to the 600 units available. ***Move the Cursor to Cell C4. Type***

L

This completes the entry of constraints.

1.6 Provide a Name for and enter the Column of Right Hand Side Coefficients (which are of course entered at the left of the matrix). The RHS column can have any name. In chapter 9, the name B is used. ***Move the cursor to cell C1. Type***

B

Type all the nonzero RHS values in column C beginning with cell C3. (Note that cell C2 is left blank).
Move the cursor to cell C3 Type 160
Move the cursor to cell C4 Type 600

1.7 Provide a name for each activity.

The names you wish to assign to the activities are entered in row 1 beginning with column D. Activity names are restricted to 8 characters and should begin with an alphabetic character. All names should be unique. Do not use the same names that you used to identify the rows. Include only the real activities of the problem. The program will generate any required slack, surplus, and artificial activities.

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Move the cursor to Cell D1. Type

CORN133

Move the cursor to Cell E1. Type

SORGHUM

1.8 Enter the data for each activity.

Objective function values are included in row 2. Both activities are defined in terms of one acre of land. The CORN133 activity returns $58.76 per acre of land.

Move the cursor to cell D2. Type

58.76

Input-output coefficients which reflect the amount of input required per unit of output are included in the cells below row 2 and to the right of column C. One unit of CORN133 requires one acre of LAND.

Move the cursor to cell D3. Type

1

(Note that this is number 1, not small letter L.)

One unit of CORN133 requires 1.68 units of LABOD.

Move the cursor to cell D3. Type

1.68

One acre unit of the SORGHUM activity returns $45.48.

Move the Cursor to Cell E2. Type

45.48

The SORGHUM activity requires one acre of LAND.

Move the cursor to cell E3. Type

1

The SORGHUM activity also requires 0.66 units of labor in the months of October, November and December. (LABOD).

Move the cursor to cell E4. Type

.66

The computer screen should now contain all the information shown in Figure 7.1 above. All cells below row 4 should be blank. All cells to the right of column E should be blank.

The tableau on the screen is a tabular form of the following algebraic problem

Maximize C = 58.76*CORN133 + 45.48*SORGHUM

Subject to

1*CORN133 + 1 *SORGHUM <= 160

1.68*CORN133 + .66*SORGHUM <= 600.

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Also for linear programming problems, the value of the choice variables must be positive or zero. Hence, the following restrictions are implicitly included and need not be explicit in the tableau.

CORN133 >= 0
SORGHUM >= 0.

After the tableau is entered, the LP portion of the worksheet should be EXTRACTED and saved on disk. For example, the tableau portion of this problem might be Xtracted and saved as EX1.

Move the cursor to Cell A1
Type ***/ F X V*** (for / File Xtract Values)
Enter Xtract File name: ***EX1***
Enter Xtract Range: ***A1.E4***

2. Use MUSAH86 to solve the Linear Programming Problem

There are times when you might wish to save the main tableau as a separate master file. However for this problem, it is time to leave the LOTUS program temporarily and solve the linear programming problem. In Lotus version 2, you have the ability to "Suspend" work on a worksheet and run another program providing you have sufficient computer memory. The way leave LOTUS temporarily ***is by typing***
/ S (for / SYSTEM).
You should now see the DOS system prompt, A>. At this time,

Remove the LOTUS system disk from Drive A:
Insert the MUSAH program disk in Drive A:
Type MUSAH86

You should see the MUSAH screen which is shown in Figure 7.2. The prompts to the user are located at the bottom of the MUSAH screen.

2.1 Provide the Name of the Input File. The first prompt which is shown at the bottom of Figure 7.2 asks you to provide the name of the Lotus file containing the Linear Programming Tableau. Since we saved the Xtracted file under the name EX1 on drive B:, then type B:EX1 in response to the first prompt

Please specify the name of the input file--> ***B:EX1***

2.2 Provide the Name of the Output File Where the Linear Programming Solution will be stored. It is suggested that you use a name which is similar but not identical to the name used for the input file. For example, the name EX1SOL might remind you that this file contained the solution output from Example 1.

Please specify the name of the output file--> ***B:EX1SOL***

As soon as the name of the output file has been entered, the MUSAH program will begin. The iterations used in the Simplex method of solving linear program are listed on the screen. When the problem has been solved, you will see the message

Solution..... OPTIMAL

on the screen. The information on your computer screen should be the same as shown in Figure 7.3. It will be necessary to save the solution so it can be reviewed when we return to Lotus. Respond yes (Y) to the prompt at the bottom of the screen

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```
(C) 1987, Dept Agricultural Economics, Oklahoma State Univ. Stillwater, OK, USA.
==================================================================
      Problem Name........                Iteration.............
      Objective...............            Solution.............
      Objective Name.......               Activity In..........
      Rhs Name............                Activity Out.........
                                          Objective Value.....
      Total Columns........
      Real....................
      Slack...................
      Artificial..............
      Total Constraints.....
      Less Than.............
      Greater Than..........
      Equality................

      Input File..............
      Output File............
------------------------------------------------------------------
Please specify the name of the input file-->
```

Figure 7.2 Initial Input Screen for MUSAH Linear Programming Routine.

```
------------------------------------------------------------------
(C) 1987, Dept Agricultural Economics, Oklahoma State Univ. Stillwater, OK, USA.
==================================================================
      Problem Name        EX1                 Iteration           1
      Objective           MAXIMIZE            Solution            OPTIMAL
      Objective Name      C                   Activity In         CORN133
      Rhs Name            B                   Activity Out        LAND
                                              Objective Value     9.40160000E+03
      Total Columns       4
         Real             2
         Slack            2
         Artificial       0
      Total Constraints   2
         Less Than        2
         Greater Than     0
         Equality         0

      Input File          ex1
      Output File         ex1o
------------------------------------------------------------------
Store solution? (Y/N)  Y
```

Figure 7.3. Input Screen For MUSAH Linear Programming Routine After Solution of Problem EX1.

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Store solution? (Y/N) **Y**

After the solution has been saved you will be asked if you want to solve another problem. If you have a lot of linear programming problems to solve it is efficient to save each of them as separate problems and then solve them one after another. However we have only one problem to solve, so respond No (N) to the prompt

Solve another Problem? (Y/N) **N**

2.3. Return to Lotus. After the last prompt, you will exit the MUSAH program and return to DOS where you will see the system prompt.

A>

You need not reinsert the LOTUS system disk since we left Lotus is in a suspended state. The Lotus program has remained in the computer memory while we used the MUSAH program. To return to the suspended Lotus worksheet type EXIT in response to the A> prompt to exit from DOS.

A> ***EXIT***

You should now see the original worksheet on your screen. However the solution results from MUSAH are stored in the file EX1SOL. ***Type***

/ F R b:ex1sol (for / File Retrieve filename),

to retrieve the worksheet containing the solution file. The file that you retrieved contains a copy of the original input along with the output. The lower part of the worksheet contains the solution which is shown in Figure 7.3.

	A	B	C	D	E	F
9						
10	Solution					
11	OPTIMAL					
12	function Value:	9401.6				
13	==========					
14					SORGHUM	LAND
15					45.48	0
16	Returns	Name	Type	Level	real	slack
17	----------					
18	58.76	CORN133	real	160	1	1
19	0	LABOD	slack	331.2	-1.02	-1.68
20	----------					
21	Z				58.76	58.76
22	Shadow Price				13.32	58.76
23	==========					

.gure 7.4. Linear Programming Solution in MUSAH Format for Problem EX1.

Those who are more experienced with the Simplex method will recognize the solution output is the same final tableau which would be obtained by hand solution of the linear programming problem.

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The optimal value of the objective function is given as 9401.6. With the optimal plan, the return to resources LAND and LABOD will also be 9401.6.

The activities which are in the final solution (in the final basis) are listed in the column labeled Name. The type (real, slack) of the activities in the final basis is listed in the column labeled Type. The column labeled "Level" indicates the optimal solution values for the real activities and the optimal slack quantities for the slack activities in the optimal solution.

The optimal plan is to produce 160 acres of CORN133. In this example, the net farm income of 9401.6 would be derived from the production of corn (160*58.76 = 9401.6). All available Land is used and allocated to the CORN133 production activity. The supply of labor was in excess of the amount needed. There were 331.2 hours of LABOD in slack which means that only 268.8 (600-331.2) hours were used..

The bottom row of the tableau indicates that the "shadow price" of SORGHUM is $13.28. If the farmer decided to produce an acre of SORGHUM, one acre less of CORN133 could be planted. However the estimated return to the fixed resources (the value in Z row and SORGHUM column) is $58.76 per acre which is $13.28 less than the $45.48 net income for sorghum. Thus each acre of sorghum which replaced an acre of Corn would reduce net farm income by $13.28. Thus the shadow prices for "real" activities indicate an opportunity cost or "income penalty" value associated with nonbasic activities.

The Shadow Price of LAND is computed by the program to be $58.76 per acre. This indicates that the last (marginal) unit of land contributed an additional $58.76 to the value of the objective function. Since the resource LABOD is in "slack", it is not scarce and thus the last unit, the 600th hour does not increase the value of the objective function. Thus its value or Shadow Price is zero.

STEPS FOR USING MUSAH86 TO SOLVE PROBLEM EX2

The LP model for EX2 in chapter 9 is derived from EX1 by adding an additional activity. In the previous section of the tutorial EX1 was stored on the LOTUS data disk. Thus to build EX2

3.1 Retrieve EX1 from the disk. ***Type***

/ F R B:EX1 for (/ file retrieve filename).

3.2 Add the CRNSORRT activity in column F.

Move the cursor to cell F1 Type CRNSORRT
Move the cursor to cell F2 Type 109.43
This is the objective function value (expected gross margin) for two acres the crop rotation activity.

Move the cursor to cell F3 Type 2
This activity takes two acres, one acre of land for sorghum and one acre of land for corn.

Move the cursor to cell F4 Type 2.34

This is the amount of labor required for the two acre unit during the October through December period.

3.3 Save the spreadsheet as EX2. It is better to use the Xtract option so that only the tableau portion of the worksheet is saved.
Type / F X V (for / file xtract values)
Enter Name of Xtract file: ***B:EX2***
Enter Range to Xtract ***A1.F4***

3.4 Suspend the LOTUS worksheet, ***type***
/ S (for / System)

3.5 Be sure the MUSAH program disk is in Drive A, type MUSAH86 at the DOS prompt

A> ***MUSAH86***

3.6 Use MUSAH to solve the problem by responding to prompts as shown below

Please specify the name of the input file--> ***B:EX2***
Please specify the name of the output file-->***B:EX2SOL***
Store solution? (Y/N) ***Y***
Solve another Problem? (Y/N) ***N***

3.7 Return to the Lotus worksheeet by typing Exit at the Dos system prompt
A> ***EXIT***

3.8 Review the solution by retrieving the solution file
Type / F R b:ex2sol

Compare the solution with that on page 14 in chapter 9.

ADDITIONAL EXAMPLE PROBLEMS

Thirteen example problems are included in Chapter 9. Solution tableaus for many of the problems are also included in the text. Use the MUSAH program in conjunction with LOTUS to solve each of the problems.

Problem Name	Distinguishing Characteristic
EX3	Alternative input levels for the same crop, a factor-product problem
EX4	Input purchasing (or buying) activity (nitrogen in the form of ammonium nitrate).
EX5	Activities for alternative levels of inputs provided from alternative sources, a factor product and factor-factor problem.
EX6	A factor-product (optimal quantity of nitrogen to apply) factor-factor (optimal source of nitrogen), and

	product-product problem (optimal combination of crops)
EX7	Selling (or marketing) activities for corn and sorghum.
EX8	Selling (corn and sorghum) and purchasing (ammonium nitrate) activities.
EX9	Labor purchase activities and inclusion of a reservation wage for family labor.
EX10	Multiple labor periods.
EX11	Household consumption function in which consumption of sorghum is a function of household income.
EX12	A linear consumption function in which consumption of sorghum is a function of household income.
EX13	A multiple region model with fixed demands and transportation activities. (Note that the objective is to MINIMIZE rather than MAXIMIZE the cost of meeting fixed food demands.)

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Lesson 8

A SPREADSHEET FOR COMPUTATION OF COSTS AND BENEFITS FROM MARKET INTERVENTION: AN EXAMPLE FROM THE LIBERIAN RICE ECONOMY

Prepared by Elton Li and Luther Tweeten

OBJECTIVE

INTRODUCTION

Government intervention in markets is very common. Sometimes these interventions correct market failure and sometimes these interventions result in even less efficient and equitable allocations. The calculation of costs and benefits from market interventions is an important first step in the analysis of market policy.

References for this lesson include

Tweeten, Luther, "Introduction to Agricultural Policy Analysis: The Distribution of Economic Costs and Benefits from Market Intervention", APAP Bul B-5, Oklahoma State University, June 1985.

Tweeten, Luther, "Classical Welfare Analysis", Chapter 6 in *Policy Analysis Tools for Economic Development*. (in publication) Oklahoma State University. 1988

OBJECTIVES

This lesson is a supplement to the paper "Introduction to Agricultural Policy Analysis: The Distribution of Economic Costs and Benefits from Market Intervention" by Dr. Luther Tweeten. The objective is to construct a LOTUS worksheet to perform calculations to determine gains and losses from government market intervention policies. The necessary calculations are described on pages 50-54 of APAP Bulletin B-5.

You are to enter the formulas and data to complete the worksheet listed in Figure 6.1. Most of the labelling of the worksheet is already completed and stored in the file GOL. You are to fill in the necessary numbers and formulas in columns D, E, and F. The completed worksheet file should again be stored with the name GOL.

SUGGESTED PROCEDURE

(1) Bring up LOTUS in the usual manner. ***Then retrieve the worksheet GOL using the /File Retrieve command.***

(2) ***Enter the necessary data and formulas to complete the worksheet.*** The completed worksheet should be the same as the one in Figure 6.1.

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You should notice that much of the tedious labelling of formatting of the worksheet is already done. All you need to do is to fill in the numbers and formulas in columns D, E, and F of the worksheet.

You may notice that column A had been set to a width of 5 characters. This column is reserved for an "item number". This "item number" is used in the labels in column B to indicate how computations should be done for a computed item. In cell B14, for example, item (4) is specified to be calculated as (1)*(3). Item '(1)' refers to row 8 and item '(3)' refers to row 12. ***Thus the appropriate formula for Cell D14 is +D8*D12.***

(3) Column B contains the item names. It is set to a width of 35. The item name of a computed item also contains an indication of how the computation should be done.

(4) Column C contains the units for the items. It is set to a column width of 14.

(5) Column D, E, and E contain the numbers and formulas for 1982, 1983, and 1884 respectively. These columns had been formatted to display 2 decimal places. These are the columns you are to fill in.

Hint: Concentrate on column D first. Items that do not have instructions on how they should be computed are just numbers. They are simply to be typed in. Otherwise, the item should be computed with a formula.

It will be easier to use the "pointing method" when entering in the formula. This is a good place to practice using the "pointing method" when keying in formulas.

After you have made the numbers in column D come out correctly, work on columns E and F simultaneously. For non-computed items, you should just enter in the numbers. Formulas for computed items can easily be copied from the corresponding items in column D using the /Copy command.

(6) When you have finished, save the worksheet with the /File Save command and use the old name GOL. You should REPLACE the old version of GOL on the disk.

Figure 8.1 Completed Government of Liberia Spreadsheet for Deterimining Gains and Losses from Market Intervention

	A	B	C	D	E	F
1	Gains and Losses from Goverment Policies, Liberian Rice Economy					
2						
3						
4		Producers (Farm Level) P				
5		Item	Units	1982	1983	1984
6						
7	(1)	Domestic production sold				
8		to LPMC	1000 mt paddy	10.00	17.19	9.25
9	(2)	Guaranteed producer				
10		price	$/mt (18c/lb)	396.90	396.90	396.90
11	(3)	Effective producer				
12		price	$/mt (12c/lb)	264.60	264.60	198.36
13	(4)	Producer receipts				
14		(1)*(3)	$1000	2646.00	4548.47	1834.83
15	(5)	Normal market price,				
16		farm Level	$/mt (8c/lb)	176.40	176.40	176.40
17	(6)	Producer subsidy				
18		(3)-(5)	$/mt (4c/lb)	88.20	88.20	21.96
19	(7)	Policy transfer to producers				
20		(1)*(6)	$1000	882.00	1516.16	203.13
21	(8)	Proportional subsidy				
22		(6)/(5)*100	Percent	50.00	50.00	12.45
23	(9)	Direct price elasticity of				
24		market surplus	None	1.30	1.30	1.30
25	(10)	Quantity generated by production				
26		subsidy (1)*(8)*(9)/[illegible]	1000 mt	6.50	11.17	1.50
27	(11)	Production value loss				
28		0.5*(6)*(10)	$1000	286.65	492.75	16.44
29	(12)	Gain to producers (Addition to				
30		producer surplus (7)-(11)	$1000	595.35	1023.41	186.69
31	(13)	Production value loss per unit of				
32		gain to producers (11)/(12)	$	0.48	0.48	0.09
33	(14)	LPMC quantity sold from local				
34		production	1000 mt	4.00	5.35	5.15
35	(15)	LPMC marketing cost of local				
36		production sold	$/mt	205.06	205.06	205.06
37	(16)	Normal marketing cost for				
38		competitive sector	$/mt	132.30	132.30	132.30
39	(17)	Excess resource cost of marketing				
40		(15-16)*(14)	$1000	291.04	389.27	374.71
41	(18)	LPMC purchases less sales				
42		(1)-(14)	1000 mt	6.00	11.84	4.10
43	(19)	Value lost from waste				
44		.5*(5)*(18) (assume half of loss)	$1000	529.20	1044.29	361.62
45	(20)	Sum of social costs				
46		(11)+(17)+(19)	$1000	1106.89	1926.31	752.77
47	(21)	Social cost per unit gain to				
48		producers (20)/(12)	$	1.86	1.88	4.03
49						

Figure 8.1 Completed Government of Liberia Spreadsheet for Deterimining Gains and Losses from Market Intervention (Continued)

	A	B	C	D	E	F
52						
53		Consumption (Wholesale level) C				
54		Item	Units	1982	1983	1984
55						
56	(1)	Total quantity marketed				
57		and consumed	1000 mt	95.40	102.40	102.40
58	(2)	Support price				
59		wholesale	$/mt	465.00	440.00	474.00
60	(3)	Consumption cost				
61		(1)*(2)	$1000	44361.00	45056.00	48537.60
62	(4)	Computed cif world wholesale				
63		price	$/mt	419.50	391.10	403.00
64	(5)	Consumption tax				
65		(2)-(4)	$/mt	45.50	48.90	71.00
66	(6)	Policy tax on consumers				
67		(1)*(5)	$1000	4340.70	5007.36	7270.40
68	(7)	Proportinal tax				
69		(5)/(4)*100	Percent	10.85	12.50	17.62
70	(8)	Commercial				
71		imports	1000 mt	50.00	55.00	55.00
72	(9)	Excise tax on commercial				
73		imports 0.03*(4)	$1000	12.59	11.73	12.09
74	(10)	Economic rent to commercial				
75		importers (5-9)*(8)	$1000	1645.75	2044.18	3240.05
76	(11)	LPMC:				
77		(a) PL480	1000 mt	43.00	45.00	45.00
78		(b) In-country purchases	1000 mt	2.40	2.94	2.68
79		(c) Total	1000 mt	45.40	47.94	47.68
80	(12)	Policy tax transfer to GOL				
81		(5)*(11c)+(10)	$1000	3711.45	4388.45	6625.33
82	(13)	Direct price elasticity of				
83		Demand	None	-0.60	-0.60	-0.60
84	(14)	Consumption lost by tax				
85		(1)*(7)*(13)/-100	1000 mt	6.21	7.68	10.82
86	(15)	Consumption value loss				
87		.5*(5)*(14)	$1000	141.24	187.82	384.27
88	(16)	Loss to consumers				
89		(6)+(15)	$1000	4481.94	5195.18	7654.67
90	(17)	Consumption value lost per unit of				
91		tax (15)/(12)	$	0.04	0.04	0.06
92	(18)	Spoilage and waste				
93		above normal	1000 mt	1.50	1.50	1.50
94	(19)	Cost of spoilage				
95		(4)*(18)	$1000	629.25	586.65	604.50
96	(20)	Gain to commercial importers				
97		(6)-(12)	$1000	629.25	618.91	645.07

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Figure 8.1 Completed Government of Liberia Spreadsheet for Deterimining Gains and Losses from Market Intervention (Continued)

	A	B	C	D	E	F
100						
101		Item	Units	1982	1983	1984
102						
103						
104		PRIVATE SECTOR				
105						
106		+ Gain to producers				
107		(12P)	$1,000	595.35	1023.41	186.69
108		- Loss to consumers				
109		(16C)	$1,000	4481.94	5195.18	7654.67
110		+ Gain to Commercial importers				
111		(20C)	$1,000	629.25	618.91	645.07
112						
113		NET	$1,000	-3257.34	-3552.87	-6822.90
114						
115		PUBLIC SECTOR				
116						
117		- Policy transfer to producers				
118		(7P)	$1,000	882.00	1516.16	203.13
119		- Excess cost of country market				
120		(17P)	$1,000	291.04	389.27	374.71
121		- Value loss from country waste				
122		(19P)	$1,000	529.20	1044.29	361.62
123		+ Policy transfer from consumers				
124		to GOL (12C)	$1,000	3711.45	4388.45	6625.33
125		- Spoilage and Waste				
126		(19C)	$1,000	629.25	586.65	504.50
127						
128		NET	$1,000	1379.96	852.09	5081.37
129						
130		Net cost of public intervention				
131		to society (Loss to private sector				
132		less gain to public sector)	$1,000	1877.38	2700.78	1741.54
133						

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Lesson 9

EVALUATION OF AGRICULTURAL PROJECTS USING LOTUS 1-2-3

Part 1

Prepared by Elton Li, Dean Schreiner, and Art Stoecker

OBJECTIVE

The purpose of this lesson is to demonstrate how LOTUS 1-2-3 can be used for performing computations and tabulations often required in the evaluation of agricultural projects. Use is made of the LOTUS @IF statement for making decisions. The financial functions for loan ammortization (@PMT), for net present value (@NPV), and for the internal rate of return (@IRR) are illustrated.

You are to derive the worksheet shown in Figures 9.1 - 9.4. To save you from tedious typing, a template containing much of the labelling and some of the numbers are provided. This starting worksheet called PROJBLK1 is shown in Figures 9.1 and 9.2.

References: Schreiner, D.F. "Agricultural Project Investment Analysis." Chapter 10 in *Agricultural Policy Tools for Economic Development.*

O'Leary, T.J. *The Student Edition of Lotus 1-2-3.* Addison-Wesley Publishing Co., New York.

Gittenger, J.P. *Economic Analysis of Agricultural Projects.* John Hopkins University Press, 1982.

Ewing, D.P. and D.F. Noble. *Using 1-2-3, Special Edition.* Que Corp., Carmel, Ind., 1987.

PROCEDURES

(1) ***First start LOTUS in the usual manner. Then use the /File Retrieve commands to load the worksheet named PROJBLK1.*** Your final worksheet should be saved under the name PROJ1. To avoid disaster, you should periodically save your worksheet.

Explore the worksheet and compare it with the accompanying figures. Almost all of the labelling is already done for you. Also some of the figures, such as those in Row 9 and Row 10 are already done for you. We will supply the procedures to fill in the formulas.

Figure 9.4 is not provided in PROJBLK1. You will develop Figure 9.4 from Figure 9.3 by the /COPY and some minor "surgery." This will be discussed in more detail later.

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(2) Row 9 and Row 10 (i.e. Yield and Prices) are given. Row 11, the GROSS VALUE OF PRODUCTION, is simply the product of YIELD and PRICE. The appropriate formula for Cell E11 is:

+E9*E10

Enter this formula now. Then format Cell E11 using

/Range Format , 0

The "," format inserts comma at every third digit of the number and also inserts parenthesis around negative numbers. We specify the number of decimal places to be 0 since we wish to display the number rounded off to the nearest Rs. We will use this format to display most of the numbers in this lesson unless specified otherwise.

Now use the /Copy command to copy the formula in Cell E11 to the rest of Row E in Figure 9.1. It is worth noting that when you /Copy, not only the formula gets copied, but the formatting of the source cell (in this case E11) as well.

(3) In Row 14, LAND RENT is given. Row 16 (WORK DAYS) and Row 17 (WAGE) are also given. LABOR COST in Row 18 is the product of WORK DAYS and WAGE. Thus the appropriate entry in E18 is:

+E16*E17

Enter this formula now. We will also remind you for the last time that unless otherwise specified, all numbers should be displayed with the , format with 0 decimal place. ***The best thing to do is to format this one cell now so that the /Copy command will copy this format to the range you copy the cell to. Fill in the rest of the entries of Row 18 with the /COPY command.***

(4) In Row 19, the data for MATERIAL COST are given.

(5) In Row 20, INVESTMENT COST is equal to LAND RENT plus LABOR COST plus MATERIAL COST for YEAR 1 to YEAR 3 and zero for other years. We could insert this summation in Cells E20, F20, and G20 (the first 3 years), and insert zeros for the rest of Row 20. But instead, we will introduce use of the @IF function in LOTUS. Here is how it works:

In cell E20, insert the following formula:

@IF(E5<=3,E14+E13+E19,0)

Which says, in plain English: If the value of Cell E5 (YEAR) is less than or equal to 3, insert (in Cell E20) the value E14+E18+E19, otherwise (that is when E1 is NOT less than or equal to 3), insert (in Cell E20) the value zero. ***Enter the formula for cell E20 now.***

In general, the @IF function in LOTUS has the following form:

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Figure 9.1: Value of Production, Investment, and Operating Expenditure, 1-Hectare Planting Model, Cashewnut Project, Small Holder Component, Karnataka, India

ITEM	Unit	Project Year 1	2	3	4	5	6	7	8	9	10	11 - 20
Value of Production												
Yield	Kg/Ha	0	0	0	50	150	400	600	700	800	900	900
Price	Rs/Kg				5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Gross Value of Production	Rs	0	0	0	255	765	2,040	3,060	3,570	4,080	4,590	4,590
Investment and Operation Expend.												
Land Rent (Opportunity Cost)	Rs	0	0	0	0	0	0	0	0	0	0	0
Labor												
Work Days	Units	110	56	62	40	49	53	59	63	67	71	71
Wage	Rs/Day	8	8	8	8	8	8	8	8	8	8	8
Labor Cost	Rs	880	448	496	320	392	424	472	504	536	568	568
Material Cost	Rs	260	360	490	570	595	595	595	595	595	595	595
Investment Cost	Rs	1,140	808	986	0	0	0	0	0	0	0	0
Total Operating Expenditures	Rs	0	0	0	890	987	1,019	1,067	1,099	1,131	1,163	1,163

Figure 9.2: Unit Activity Budget, 1-Hectare Planting, India Cashew Nut Project

ITEM	Unit	Project Year 1	2	3	4	5	6	7	8	9	10	11 - 20
Inflow												
Gross Value of Production	Rs	0	0	0	255	765	2,040	3,060	3,570	4,080	4,590	4,590
Subsidy	Rs	300	300	300	0	0	0	0	0	0	0	0
Total	Rs	300	300	300	255	765	2,040	3,060	3,570	4,080	4,590	4,590
Outflow												
Investment	Rs	1,140	808	986	0	0	0	0	0	0	0	0
Operating Expenditures	Rs	0	0	0	890	987	1,019	1,067	1,099	1,131	1,163	1,163
Incremental Net Benefit												
Before Financing	Rs	(840)	(508)	(686)	(635)	(222)	1,021	1,993	2,471	2,949	3,427	3,427
Financing (Assuming Interest Rate = 0.12)												
Loan Receipts	Rs	620	396	562	555	124	0	0	0	0	0	0
Dept Outstanding	Rs	620	1,090	1,783	2,552	2,783	3,340	2,815	2,226	1,566	827	0
Dept Service	Rs	0	0	0	0	0	927	927	927	927	927	0
Net Financing	Rs	620	396	562	555	124	(927)	(927)	(927)	(927)	(927)	0
Incremental Net Benefit												
After Financing	Rs	(220)	(112)	(124)	(80)	(98)	94	1,066	1,544	2,022	2,500	3,427
Farm Income	Rs	660	336	372	240	294	518	1,538	2,048	2,558	3,068	3,995

.94'

@IF(condition, true-value, false-value)

where condition is an expression that is either TRUE or FALSE. In the above example, the condition is E5<=3, (where <= stands for less than or equal to). In our particular case, this is TRUE. If the condition is TRUE, the @IF function will insert 'true-value' in the cell containing the @IF function. 'true-value' can either be a formula, a number, or another function. In this case it is a formula, namely E14+E18+E19. Similarly, if the condition is FALSE, the @IF function will insert 'false-value' in the cell containing the @IF function. Again, 'false-value' can either be a formula, a number, or another function. In our case above it is a number, namely zero.

Since E5<=3 is indeed TRUE, Cell E20 should display the value of E14+E18+E19. ***Format this cell. Then copy Cell E20 to the rest of Row E.***

Move the cursor to Cell H20 and inspect the formula there. Why does cell H20 display zero?

(6) TOTAL EXPENDITURE in Row 21 is the opposite of INVESTMENT COST. It is equal to LAND RENT plus LABOR COST plus MATERIAL COST for years 4-20 and zero otherwise. Thus the appropriate formula for Cell E21 is:

@IF(E1>=4,0,E14+E18+E19)

Enter this formula cell E21. Then format this Cell and copy it to the rest of the row. This completes our Figure 9.1. ***This is a good time to save the worksheet before proceeding further. Save it under the name PROJ1.***

(7) We now begin with Figure 9.2. Row 34, namely GROSS VALUE OF PRODUCTION should be the same as the corresponding entry in Figure 9.1. (Row 11). ***Thus define Cell E34 to be +E11. Then /Format the cell and /Copy it to the rest of the row.***

The amount of the SUBSIDY in Row 35 is given. ***However, the TOTAL in Row 36 is the GROSS VALUE OF PRODUCTION plus the SUBSIDY. Enter the necessary formula in Cell E36, /Format cell E36, and /Copy cell E36 to the rest of Row 36.***

(8) Both INVESTMENT and OPERATING EXPENDITURES in Rows 39 and 40 respectively are the same as the corresponding items in Figure 9.1 (Rows 20 and Rows 21). Thus we can simply ***enter the formulas +E20 and +E21 in Cells E39 and E40, respectively. Then format these two cells and /Copy them to the rest of Rows 39 and 40.***

(9) In Row 43, INCREMENTAL NET BENEFIT is TOTAL INFLOW (Row 36) minus INVESTMENT (Row 39) minus OPERATING EXPENDITURES (Row 40). ***Insert the appropriate formula in Cell E43. Then /Format the cell and /Copy it to the rest of the row.***

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(10) The FINANCING section begins at Row 45. Notice that cell E45 contains the number 0.12, the ASSUMED INTEREST RATE.

(11) The amount of money which can be borrowed on a project depends on negotiations between the borrower and lender. We will assume the agreement is that 75 percent of the labor plus all of the material cost can be borrowed. In Row 47, LOAN RECEIPTS is assumed to be 75 percent of LABOR COST (Row 18 in Figure 1), plus MATERIAL COST (Row 19 in Figure 1), minus TOTAL INFLOW in Row 36. Thus the formula for Cell E47 appears to be ***(don't enter yet)***:

0.75*E18+E19-E36

However, if the above is negative, LOAN RECEIPTS should be zero (it does not make sense to have a negative LOAN RECEIPT). Yes, this is another place where an @IF function is appropriate. ***So the appropriate formula for Cell E47 should be:***

@IF(0.75*E18+E19-E36>0,0.75*E18+E19-E36,0)

Which in plain English means that if 0.75*E18+E19-E36 is positive (i.e. >0), then the value of Cell E47 should be that positive value, i.e. 0.75*E18+E19-E36, otherwise, insert a zero in Cell E47.

Enter in the formula now. Then /Format the cell and /Copy it to the rest of the row. Inspect the formulas in other cells in this row and make sure you understand them.

(12) Row 48 contains the calculations for DEBT OUTSTANDING. DEBT OUTSTANDING for a certain year is the DEBT OUTSTANDING for the previous year times 1 plus the INTEREST RATE, plus LOAN receipt of the current year, less DEPT SERVICE of the same year. For the first year however, there is no DEBT OUTSTANDING for last year, in this case DEBT OUTSTANDING for year 1 is simply LOAN RECEIPTS less FINANCING. ***Thus the appropriate formula for Cell E48 is simply:***

+E47-E49

Whereas the appropriate formula for Cell F48 is:

+E48*(1+$E$45)+E47-E49

Enter in these formulas now, then /Format them and /Copy Cell F48 to the rest of Row 48.

(13) Row 49 is the DEBT SERVICE or loan repayment. The time when loan repayments must begin is also dependent on the terms of the particular loan being analyzed. We assume that for this particular project, we start repayment at year 6 and then repay the loan in 5 equal annual payments. ***Thus simply insert zeros for the first five years in Row 49.***

The appropriate ***formula for Cell J49*** should be:

@PMT(J48,$E$45,5)

The @PMT function in LOTUS calculates loan payment based on principal, (in this case the OUTSTANDING DEBT in Cell J48), at certain INTEREST rate (in Cell E45) for a number of periods (in this case 5).

The appropriate formula for Cell K49 should be:

@PMT(K48,$E$45,4)

Similarly the appropriate formulas for Cells L49, M49 and N49 should be respectively:

@PMT(L48,$E$45,3)

@PMT(M48,$E$45,2)

@PMT(N48,$E$45,1)

The best way to do this is to type the formula in cell J49, then /Copy this cell to K49.N49. Then use the F2 key to edit the number of periods in K49, L49, M49 and N49 from 5 to respectively 4, 3, 2, and 1.

Now insert a zero in Cell O49. To complete the work on this row, invoke the /Format command to format this row appropriately.

NOTE: Actually in this case, we could have inserted the formula:

@PMT($L$48,$E$45,5)

in all of Cells J49, K49, L49, M49, and N49. Or alternatively we could just insert @PMT($L$48,$E$45,5) in Cell J49 and insert the formula +$J$49 in Cells K49, L49, M49 and N49 since all payments are equal because no additional money was borrowed after the loan re-payment (DEBT SERVICE) began. We prefer the way we do it in order to handle the possibility of analyzing cases where it is necessary to borrow additional money after loan repayments have begun. We have assumed the LOAN RECEIPTS to be 75 percent of LABOR COSTS, PLUS MATERIAL COST, MINUS INFLOW INCLUDING SUBSIDY. When we perform sensitively analysis by changing PRICES, YIELDS, WAGE and so on, there is no guarantee that we will not have additional loan receipts after we begin our paying back the loan.

(14) ***Row 53, INCREMENTAL NET BENEFIT AFTER FINANCING is just as it says: it should be Row 43, namely INCREMENTAL NET BENEFIT BEFORE FINANCING, plus Row 50, namely NET FINANCING.*** Now Figure 9.2 is completed.

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Figure 9.3: Financial Analysis of India Cashew Nut Project (Rs)

	R	S	T	U	V	W	X	Y	Z	AA
	INCREMENTAL BENEFIT					INCREMENTAL COST				
Year		Gross Value of Product'n	Subsidy	Loan Recepts	Total	Invest-ment	Operat. Expend.	Debt Service	Total	INCREMENTAL NET BENEFIT (Cash-Flow)
1		0	300	620	920	1,140	0	0	1,140	(220)
2		0	300	396	696	808	0	0	808	(112)
3		0	300	562	862	986	0	0	986	(124)
4		255	0	555	810	0	890	0	890	(80)
5		765	0	124	889	0	987	0	987	(98)
6		2,040	0	0	2,040	0	1,019	927	1,946	94
7		3,060	0	0	3,060	0	1,067	927	1,994	1,066
8		3,570	0	0	3,570	0	1,099	927	2,026	1,544
9		4,080	0	0	4,080	0	1,131	927	2,058	2,022
10		4,590	0	0	4,590	0	1,163	927	2,090	2,500
11		4,590	0	0	4,590	0	1,163	0	1,163	3,427
12		4,590	0	0	4,590	0	1,163	0	1,163	3,427
13		4,590	0	0	4,590	0	1,163	0	1,163	3,427
14		4,590	0	0	4,590	0	1,163	0	1,163	3,427
15		4,590	0	0	4,590	0	1,163	0	1,163	3,427
16		4,590	0	0	4,590	0	1,163	0	1,163	3,427
17		4,590	0	0	4,590	0	1,163	0	1,163	3,427
18		4,590	0	0	4,590	0	1,163	0	1,163	3,427
19		4,590	0	0	4,590	0	1,163	0	1,163	3,427
20		4,590	0	0	4,590	0	1,163	0	1,163	3,427

Discount Rate	0.12
Net Present Value	8442.247
Benefit-Cost Ratio	1.868031
Internal Rate of Return	0.552707

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(15) We will now begin tackling Figure 9.3. First Figure 9.3 is different from Figures 9.1 and 9.2 in the sense that it is turned "sideways". In other words whereas the YEARS appear as rows in Figures 9.1 and 9.2, they appear as columns in Figure 9.3. This creates a problem for using the /Copy command. All the formulas that are already given must be manually typed in one by one without the help of the /Copy command. Fortunately most of this has already been done for you.

Explore the formulas already typed into Figure 9.3 in the worksheet and make sure you understand them before you begin. Do not begin until you understand the given formulas.

The body of the table of Figure 9.3 should be /Formatted with the , format to display 0 decimal place.

Now provide the formulas for Column U (LOAN RECEIPTS) and Column Y (DEBT SERVICE).

(16) TOTAL INCREMENTAL BENEFIT in column V is GROSS VALUE OF PRODUCTION plus SUBSIDY plus LOAN RECEIPTS. ***Thus the appropriate formula in cell V10 should be:***

+S10+T10+U10

Enter in the formula, /Format the cell, then /Copy the cell down column V.

(17) ***Similarly complete the TOTAL INCREMENTAL COST column (Column Z).***

(18) INCREMENTAL NET BENEFIT is TOTAL INCREMENTAL BENEFIT minus TOTAL INCREMENTAL COST.

Enter the formulas in column AA to subtract column Z from column V.

(19) Cell W32 should contain the NET PRESENT VALUE OF CASHFLOW. This can be done using the @NPV function of LOTUS. The @NPV function has the form:

@NPV(discount_rate, cashflow_range)

where discount_rate is a number, a cell reference or a formula representing the discount rate. In our case it should be a cell reference to W31. Cashflow_range should be a range where the cashflow series resides. In our case it should be AA10 to AA29. ***Thus the appropriate formula is:***

@NPV(W31,AA10.AA29)

Enter this now.

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(20) Cell W33, namely the Benefit-Cost Ratio, is simply the Net Present Value of the TOTAL INCREMENTAL NET BENEFIT stream divided by the Net Present Value of the TOTAL INCREMENTAL COST stream. ***Thus the entry in cell W33 should be in the form:***

@NPV(??,??..??)/@NPV(??,??..??)

Of course you have to substitute the ??'s with the appropriate Cell references.

(21) Now we come to the internal rate of return. The internal rate of return function in LOTUS is in the form:

@IRR(guess, range)

where 'guess' is your guess of what the INTERNAL RATE of return should be and 'range' is the range of cashflow. In our case substitute 'guess' with 0.5 and the range with AA10.AA29, our CASHFLOW column. ***Thus the appropriate formula for cell W31 is:***

@IRR(0.5,AA10.29)

Why do we have to guess the IRR, and how do we guess? LOTUS computes the IRR with a systematic trial and error method. It starts from an initial IRR, then computes the Net Present Value of the Cashflow to see if it is zero. If not, then LOTUS would adjust the IRR and try again, and so on. Usually LOTUS can come up with the right IRR in less than 20 trials. But if not, it will give up and display ERR. Thus it is important that the 'guess' you supply should be close enough to the true IRR. Usually a value of .1 works well. But .1 won't work in our case (try it!) There is really no big problem, if it doesn't work we would just guess again, and again, until it works. In this case 0.5 works.

We now have completed Figure 9.3.

(22) Figure 9.4 is not provided in the given worksheet. But here is our strategy to come up with it; since Figure 9.3 and Figure 9.4 are actually very similar. The only difference is that Figure 9.4 does not have the SUBSIDY, LOAN RECEIPTS and the DEBT SERVICE columns. Now the absence of these three columns also means that we would have to adjust the formulas in TOTAL INCREMENTAL BENEFIT and TOTAL INCREMENTAL COST since we cannot refer to columns that are not there. We will first copy Figure 9.3 and then perform surgery on the copy to arrive at Figure 9.4.

So invoke the /Copy command and specify the FROM range as R1.AA35. The TO range should be AC1.

(23) ***Now change the Title in Cell AC2 appropriately.***

(24) Now we have to get rid of three columns, namely LOAN RECEIPTS, DEBT SERVICE and SUBSIDY. ***Before you go any further, save you worksheet so that if you make a serious mistake, you can try again painlessly.***

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Figure 9.4: Economic Analysis of India Cashew Nut Project (Rs)

	AC	AD	AE	AF	AG	AH	AI
		INCR. BENEFIT		INCREMENTAL COST			INCREMENTAL NET BENEFIT (Cash-Flow)
Year		Gross Value of Product'n	Total	Investment	Operat. Expend.	Total	
10	1	0	0	1,140	0	1,140	(1,140)
11	2	0	0	808	0	808	(808)
12	3	0	0	986	0	986	(986)
13	4	255	255	0	890	890	(635)
14	5	765	765	0	987	987	(222)
15	6	2,040	2,040	0	1,019	1,019	1,021
16	7	3,060	3,060	0	1,067	1,067	1,993
17	8	3,570	3,570	0	1,099	1,099	2,471
18	9	4,080	4,080	0	1,131	1,131	2,949
19	10	4,590	4,590	0	1,163	1,163	3,427
20	11	4,590	4,590	0	1,163	1,163	3,427
21	12	4,590	4,590	0	1,163	1,163	3,427
22	13	4,590	4,590	0	1,163	1,163	3,427
23	14	4,590	4,590	0	1,163	1,163	3,427
24	15	4,590	4,590	0	1,163	1,163	3,427
25	16	4,590	4,590	0	1,163	1,163	3,427
26	17	4,590	4,590	0	1,163	1,163	3,427
27	18	4,590	4,590	0	1,163	1,163	3,427
28	19	4,590	4,590	0	1,163	1,163	3,427
29	20	4,590	4,590	0	1,163	1,163	3,427

Discount Rate	0.12
Net Present Worth	7924.780
Benefit-Cost Ratio	2.012065
Internal Rate of Return	0.303224

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To delete a column, first position the cursor at any cell in the column you want to delete. Then invoke:

/Worksheet Delete Column

and press enter. Do it for those three columns now.

(25) If you do everything right, you should see a whole bunch of ERR in your worksheet. This means that some formulas in your worksheet have errors in them. ***Move to cell AH10 and examine the formula.*** It should contain something like this:

AF10+AG10+ERR

In Figure 9.3, this formula used to be INVESTMENT plus OPERATING EXPENDITURE, plus DEBT SERVICE. But now the DEBT SERVICE column has been deleted. You cannot refer to something that is not there anymore. Thus LOTUS just gave up and substituted ERR for the Cell that you have deleted. ***Use the F2 key to eliminate the +ERR part of the formula in AH10. Then copy the formula down the column.***

(26) ***Now fix Column AE similarly.*** This time you have to eliminate two ERR's.

(27) Notice that after you fixed the formulas in columns AE and AH, the ERR's in column AI disappeared. Move the cursor to AI10 and see what's there. It contains +AE10-AH10. Both of these cells contained ERR before. If a cell references another cell that displays ERR, it becomes ERR itself. But now neither cell AE10 nor AH10 contain ERR. Thus +AE10-AH10 is a valid formula. Column AI does not need to be fixed.

(28) Cell AG31 contains the discount rate. ***Insert +W31 (the discount rate from Figure 9.3) in Cell AG31 so that changing W31 will change AG31 automatically.*** We do not want the two discount rates to differ.

(29) ***Inspect cells AG32, AG33 and AG33 to make sure they contain the correct formulas. Adjust the formulas if they are not correct.***

(30) ***Put the final touches on Figure 9.4. In particular adjust the column width of Column AC. Make sure your version matches the version in the accompanying printouts.***

(31) The worksheet is now completed. *Save this under the name PROJ1.*

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Lesson 10

EVALUATION OF AGRICULTURAL PROJECTS USING LOTUS 1-2-3

Part II

Prepared by Elton Li, Dean Schreiner, and Art Stoecker

OBJECTIVE

This is a continuation of lesson 9. The purpose is to demonstrate computations and tabulations often required in the evaluation of agricultural projects.

Specific computations will illustrate

1. The spreadsheet functions for computing the Internal Rate of Return and Present Value.

2. Estimation of a Crossover Discount Rate (the rate of discount at which the net present cost of two projects is equal).

We will develop the three LOTUS worksheets which are shown in Figures 10.1, 10.2, and 10.3. They should respectively be stored in the files FIG10-1, FIG10-2 and FIG10-3. Like Lesson 9, most of the tedious typing for these templates is already done for you. They are respectively stored in the templates FIG10-1, FIG10-2 and FIG10-3. So start with these templates. You should periodically save your work to avoid disaster.

Referencs: Schreiner, D.F. "Agricultural project Investment Analysis." Chapter 10 in *Agricultural Policy Tools for Economic Development.*

O'Leary, T.J. *The Student Edition of Lotus 1-2-3.* Addison-Wesley Publishing Co., New York.

Gittenger, J.P. *Economic Analysis of Agricultural Projects.* John Hopkins University Press, 1982.

Ewing, D.P. and D.F. Noble. *Using 1-2-3, Special Edition.* Que Corp., Carmel, Ind., 1987.

A. PROCEDURE FOR WORKSHEET FIG10.1

(1) ***Start up LOTUS in the usual manner. Then /File Retrieve the worksheet FIG10-1 from the instructor's disk. /File Save this worksheet under the name FIG10-1 on your disk before you begin.***

(2) ***Inspect the contents of the worksheet and compare it with Figure 10.1.*** This is a worksheet for analyzing the choice between manual and mechanical land clearing in Tunisia. We are to compute the Net Present Cost of the two alternatives,

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Figure 10.1. Choice Between Manual and Mechanical Land Clearing in Tunisia (US$)
Net Present Costs and Cross Over Discount Rate

	(A) Manual Clearing Alternative			(B) Mechanical Clearing Alternative			Difference Between Cost Streams
Project Year	Wages	Other Costs	Total Costs	Equipment Cost	Operation & Maintenance	Total Cost	
1	44,050	3,800	47,850	90,700	21,586	112,286	(64,436)
2	44,050	3,800	47,850	0	25,134	25,134	22,716
3	44,050	3,800	47,850	0	25,134	25,134	22,716
4	44,050	3,800	47,850	0	26,227	26,227	21,623
5	44,050	3,800	47,850	0	26,227	26,227	21,623
Total	220,250	19,000	239,250	90,700	124,308	215,008	24,242

	(A)	(B)
Net Present Cost at		
10 Percent	181,389	175,932
15 Percent	160,401	161,206

Crossover Discount Rate
IRR of difference between cost stream: 14.28%

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namely, Manual Land Clearing (Alternative A) and Mechanical Land Clearing (Alternative B). We would then compute the crossover discount rate.

The project has a life of 5 years. For either alternative, TOTAL COSTS are equal to WAGES plus OTHER COSTS. The TOTAL COSTS for Alternative A and Alternative B are in Columns D and G respectively. Begin with column D. ***First type the formula in Cell D10***

+B10+C10

/Range Format the cell with the , format with 0 decimal place. Then /Copy D10 to cell D11.D14.

(3) TOTAL COST for alternative B is the sum of EQUIPMENT COST and OPERATION & MAINTENACE (O&M). ***First type the formula in Cell G10, then copy the appropriate formula down the column to cells G11.G14.***

(4) Column H, from cells H10 to H14, should contain the DIFFERENCE BETWEEN COST STREAMS. This is simply TOTAL COST for Alternative A minus TOTAL COST for Alternative B. ***First type the appropriate formula in Cell H10. Then copy the formula down the column.***

(5) Row 16 is a TOTAL row. Totaling should be done with the @SUM function in LOTUS. ***Cell B16, for example, should be defined as:***

@SUM(B10.B14)

Do it now. Then format this cell appropriately and copy the formula to the rest of the TOTAL's, cells C16.H16.

(6) ***Move the cursor to Cell A20 and see what's there.*** It contains the number 10. Similarly Cell A21 contains the number 15. We have provided space to compute and display NET PRESENT COST for 2 discount rates. Also please note that the discount rates here are displayed in terms of a percentage, not a fraction. This must be taken into account when we perform the calculations.

Cell D20 will contain the NET PRESENT COST of Alternative A at the first discount rate. Insert the formula:

@NPV($A20/100,D$10.D$14)

Then format the cell with the /Range Format 0 command to be a , format with 0 decimal place.

Notice that a dollar sign is inserted in front of the A in $A20 to fix the column reference whereas we are leaving the row reference 20 in $A20 relative. This is because we are going to /Copy this formula to Cell D21, G20, and G21. Make sure you understand what would happen if instead we had specified just A20, or A$20, or $A$20. The discount rate is divided by a hundred to convert it to a fraction.

Also notice the $ signs in the range D$10.D$14. What would happen if we /Copy this formula to Cell D21 if we had not inserted the dollar signs?

(7) ***Now /Copy Cell D20 to Cell D21.***

(8) ***/Copy the range D20.D21 to the range G20.G21. Inspect the formulas in Cell D21, G20 and G21 and convince yourself that they are correct.***

(9) ***Cell G24*** should contain the internal rate of return of the DIFFERENCE BETWEEN COST STREAMS. The internal rate of return on the *difference* between the cost streams will tell us the interest rate where both methods are equally cost effective. The @IRR function of Lotus can be used here. Recalling that the @IRR function has the form:

@IRR(guess,range of cashflow)

Insert the appropriate @IRR function in this cell. Use 0.1 as the "guess". /Range Format the cell to be percent format with 2 decimal places.

(10) This worksheet is now completed. ***/File Save it under the name FIG10-1.***

B. PROCEDURE FOR FIG 10.2

(1) ***/File Retrieve the template FIG10-2 from the instructor's disk and compare it with Figure 10.2.*** This template is actually very similar to the one that you have just completed, except that the entries in Row 15 represent the figures for years 6-20. This is very common when presenting cashflow tables where the figures for the later years are all the same. This presents a problem when using the @NPV function (or other financial calculations) in LOTUS since one cannot simply specify, say, D10.D15 as the series of net cashflow. One purpose of this exercise is to present one technique to overcome this difficulty with LOTUS.

Before we begin, /File Save the worksheet under the name FIG10-2.

(2) All numbers in this table are to be formatted with the "***comma***" format with zero decimal place except for the cells containing NET PRESENT WORTH's.

(3) ***Insert the appropriate formula for the INCREMENTAL NET BENEFIT in Cell D10.***

+C10-B10

Then /Copy this cell down the column.

Figure 10.2. Choice Between Alternative Irrigation Scheme (Rp 1000)

	A	B	C	D	E	F	G	H
		(A) Small Scale Alternative			(B) Large Scale Alternative			
Project Year		Gross Cost	Gross Benefit	Incremental Net Benefit	Gross Cost	Gross Benefit	Incremental Net Benefit	Difference Between Cashflow
	1	500	0	(500)	1,500	0	(1,500)	(1,000)
	2	5	140	135	1,000	0	(1,000)	(1,135)
	3	5	140	135	100	350	250	115
	4	5	140	135	100	450	350	215
	5	5	140	135	100	550	450	315
	6-20	5	140	135	100	660	560	425
	Total	595	2,660	2,065	4,300	11,250	6,950	4,885

	(A)	(B)
Net Present Worth at		
12 Percent	441.410603	683.452638
15 Percent	292.835835	155.749501

Net Present Worth of Difference Between Cashflow	
12 Percent	242.042035
15 Percent	-137.08633

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(4) ***/Copy D10.D15 to G10.G15.***

(5) ***Cell H10*** *should be defined as:*

+G10-D10

Enter the formula and copy the formula down the column.

(6) Cell B17 contains the TOTAL of B10.B15. If you simply specify @sum(B10.B15) you would get the wrong answer. This is because B15 actually represents entries for 15 years. To compensate for this, ***enter instead:***

@SUM(B10.B14,15*B15)

then copy this formula *to the rest of the TOTAL row.* Note that you are able to use a function (15*B15), as an entry in the Lotus function.

(7) Now we are ready to tackle cell D21. This cell contains the Net Present Worth of Alternative A at the first discount rate. Normally the @NPV function in LOTUS would do the job, but not here. The reason why the @NPV function alone won't work here is precisely the same reason why @SUM(B10.B15) cannot be used to total the cashflow in step (6) above: Row 15 represents entries for 15 years. To overcome this we need a trick.

LOTUS has a function called @PV which calculates the present value of an annuity invested at a certain interest rate for a number of periods. In other words, this function works very much the same as the @NPV function except that the net cash flow for all periods are assumed to be the same. It answers the question similar to "If somebody agrees to pay me 100 dollars each year for the next 10 years, what is this arrangement worth to me today?" Since the net cash flows are the same, one needs not (and indeed must not) specify a range of cashflow. Instead one only needs to (or must) specify the payment amount for all periods. The @PV function has the form:

@PV(pmt,int,term)

where *pmt* is the amount of payment (or cashflow) for each period, *int* is the interest rate or the discount rate, and *term* is the number of periods. If you think about it, we have very much the same situation here. We need to answer the question: the project is going to return an equal amount of *pmt* Rp per year for the next *term* number of years, what is its worth today if we assumed a discount rate of *int*? To be specific, here our *pmt* is Cell D15, *int* is Cell A21, and *term* is the number 15.

Thus the formula:

@PV(D15,A21/100,15)

might work. However, the question was posed just a little bit erroneously. Since the project is not going to return D15 for the next 15 years, but rather it returns the amount in Cell D15 <u>6 years from now</u> for the next 15 years before any of this income is received. We must wait for 5 years. To adjust for this we need to discount the above amount for an additional 5 more years, that is:

@PV(D15,A21/100,15)/(1+A21/100)^5

Of course, for the first five years, the project is returning the cashflow as specified in the range of cells D10 to D14. The present worth of which can simply be calculated by the @NPV function. Thus the total NET PRESENT WORTH is just the sum of the two present worth's (don't enter this yet):

@NPV(A21/100,D10.D14)+@PV(D15,A21/100,15)/(1+A21/100)^5

But for consideration of /Copy'ing this to Cells D22, G21 and G22 later on, dollar signs must be added:

@NPV($A21/100,D$10.D$14)+@PV(D$15,$A21/100,15)/(1+$A21/100)^5

This is the appropriate formula for Cell D21. Insert the formula in there now!

(8) ***Now /Copy Cell D21 to Cell D22.***

(9) ***Now /Copy the Range D21.D22 to G21.G22.***

(10) ***The formula in Cell D25 is similar to the one in Cell D21 (Step 6), except that the cashflow series is in H10 to H15, the discount rate is in Cell A25. Put in this formula now.***

(11) ***Copy the formula in Cell D25 to Cell D26.***

(12) ***Save this worksheet under the name FIG10-2.***

(13) ***By experimentation, find the crossover discount rate of these two alternatives.*** The crossover discount rate is the rate of discount at which the discounted cost of the two alternatives is equal.

C. PROCEDURE FOR FIG 10.3

(1) ***Load up the worksheet FIG10-3 from the instructor's disk and compare it with Figure 10.3.*** The worksheet for determining the optimum size and timing of community water project. Three alternatives are considered. Like the former worksheet, some of the years are grouped. But the entries grouped are NOT per period figures: they are totals for the five years. Note that the discount rate is coded as a fraction in cell D3.

The completed worksheet should be saved with the name FIG10-3. Do it once now.

	A	B	C	D	E	F	G	H	I	J	K
1	Figure 10.3. Determining Optimum Size and Timing of Community Water Project										
2											
3	Assumed Discounted Rate:			0.05							
4											
5				Alternative I			Alternative II			Alternative III	
6											
7		O&M	Invest-		Disc'd	Invest-		Disc'd	Invest-		Disc'd
8	Project	Cost	ment	Total	Total	ment	Total	Total	ment	Total	Total
9	Year	(5-Yr Per)	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost
10											
11	0	0	565139	565139	565139	785216	785216	785216	1575420	1575420	1575420
12	1-5	223790	323533	547323	473924	0	223790	193779	0	223790	193779
13	6-10	272600	423206	695806	472071	423206	695806	472071	0	272600	184946
14	11-15	343515	573911	917426	487690	573911	917426	487690	0	343515	182607
15	16-20	447860	0	447860	186538	0	447860	186538	0	447860	186538
16	21	0	-722919	-722919	-259486	-642036	-642036	-230454	0	0	0
17											
18	Total	1287765	1162870	2450635	1925876	1140297	2428062	1894839	1575420	2863185	2323290
19											

(2) ***Total cost in cell D11 should be defined as the O&M (Operating and Maintenance) COST plus INVESTMENT COST, the formula should be:***

$B11+C11

Enter this now. Note that the $ sign in front of the B is there so that we can /Copy the formula to Column G and Column J later (why don't we need a $ sign in front of the C?)

(3) ***/Copy the formula in Cell D11 to D12.D16.***

(4) Column E is the DISCOUNTED TOTAL COST column. We have a similar situation as we did in FIG10-2 in that some of the years are grouped (but year 0 and year 21 are not). ***The entry in E11 is the entry for year 0. This need not be discounted. So simply insert the reference:***

+C11

(5) Cell E12 contains the entry for the DISCOUNTED TOTAL COST for year 1 to year 5. We need to discount the figure in Cell D12. How do we do that *without expanding the table?*

Now the entry in cell D12 is a total for 5 years. Without further information we can assume that the cost is an equal amount for each year. So we divide that figure by five to arrive at an annual cost and then ask the question: what is the present worth of a cost that is incurred (equal amount) every year for five years with a certain discount rate? This is really the same as the present value of an annuity invested at a certain interest rate for a number of periods. Thus the question clearly can be answered by the @PV function. ***Thus the appropriate entry for Cell E12 is:***

@PV(D12/5,$D$3,5)

Enter it now.

(6) Similarly, the @PV function can be used in cell E13. But this time the cost will not be incurred until 5 years from now. So the value returned by the @PV function should be discounted for 5 additional years:

@PV(D13/5,$D$3,5)/(1+$D$3)^5

Enter the formula in cell E13 now.

(7) ***Likewise enter the formulas for Cell E14 and E15 as:***

@PV(D14/5,$D$3,5)/(1+$D$3)^10

and

@PV(D15/5,$D$3,5)/(1+$D$3)^15

(8) Cell E16 represents the figure for only one year: the 21st. ***Thus we need to discount the figure in D16 by 21 years:***

+D16/(1+$D$3)^21

Enter this in Cell E16 now.

(9) ***Row 16 contains the column totals.*** Since the figures in the years grouped together are total figures, the @SUM function works without modification. ***Complete this row on your own.*** Note that the total of the TOTAL COSTS columns would be the NET PRESENT WORTH at the discount rate coded in cell D3.

(10) ***Format all the numbers in the table in Fixed Format with 0 decimal place.***

(11) ***Save the worksheet under the name FIG10-3.***

Lesson 11

EVALUATION OF AGRICULTURAL PROJECTS USING LOTUS 1-2-3

Part III

Prepared by Elton Li, Dean Schreiner, and Art Stoecker

OBJECTIVE

This lesson demonstrates the use of LOTUS 1-2-3 for computations of various discounted measures of project worth. Emphasis is placed on how sensitivity analysis is facilitated by the use of the data table features of the electronic spreadsheet program.

We will first develop template shown in Figure 11.1. The template is then expanded to incorporate possibilities of COST OVERRUN and BENEFIT SHORTFALL. This expansion is performed by the appropriate use of columns and rows insertion commands and copy commands in LOTUS. This expanded template is displayed in Figure 11.2. Finally, sensitivity analysis is implemented using the DATA TABLE facilities of LOTUS.

References: Schreiner, D.F. "Agricultural Project Investment Analysis," Chapter 10 and "Policy Applications in Natural Resource Projects," Chapter 11, *Agricultural Policy Analysis Tools for Economic Development.*

O'Leary, T.J. "Data Table Commands." *The Student Edition of Lotus 1-2-3,* Addison-Wesley, New York.

Gittenger, J.P. *Economic Analysis of Agricultural Projects.* John Hopkins University Press, 1982.

Ewing, D.P. and D.F. Noble. *Using 1-2-3, Special Edition.* Que Corp., Carmel, Ind., 1987.

PROCEDURE FOR COMPLETION OF WORKSHEET IN FIGURE 11.1

(1) ***Retrieve the template named INDOBLK and compare it with Figure 11.1.*** As can be seen, the worksheet analyses the Jatiluhur Irrigation Project in Indonesia. The project has an economic life of 30 years. INCREMENTAL COST and INCREMENTAL BENEFIT are assumed given and are already typed in. The discount factor is coded in Cell E5 as a fraction. The worksheet requires the computation of various measures of project worth, namely the NET PRESENT WORTH, INTERNAL RATE OF RETURN, BENEFIT-COST RATIO and NET BENEFIT INVESTMENT RATIO.

(2) ***Move the cursor to cell D14, fill in the appropriate formula for INCREMENTAL NET BENEFIT. Then /Copy this cell down Column D.***

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Figure 11.1. Completed INDOBLK Template

Jatiluhur Irrigation Project
Indonesia

ASSUMPTION
Discount Factor: 0.12

	A	B	C	D	E	F	G	H
					DISCOUNTED			
Year		Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit
	1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00
	2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00
	3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00
	4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00
	5	2.00	2.10	0.10	1.13	1.19	0.06	0.06
	6	0.50	2.50	2.00	0.25	1.27	1.01	1.01
	7	0.50	2.90	2.40	0.23	1.31	1.09	1.09
	8	0.50	2.90	2.40	0.20	1.17	0.97	0.97
	9	0.50	2.90	2.40	0.18	1.05	0.87	0.87
	10	0.50	2.90	2.40	0.16	0.93	0.77	0.77
	11	0.50	2.90	2.40	0.14	0.83	0.69	0.69
	12	0.50	2.90	2.40	0.13	0.74	0.62	0.62
	13	0.50	2.90	2.40	0.11	0.66	0.55	0.55
	14	0.50	2.90	2.40	0.10	0.59	0.49	0.49
	15	0.50	2.90	2.40	0.09	0.53	0.44	0.44
	16	0.50	2.90	2.40	0.08	0.47	0.39	0.39
	17	0.50	2.90	2.40	0.07	0.42	0.35	0.35
	18	0.50	2.90	2.40	0.07	0.38	0.31	0.31
	19	0.50	2.90	2.40	0.06	0.34	0.28	0.28
	20	0.50	2.90	2.40	0.05	0.30	0.25	0.25
	21	0.50	2.90	2.40	0.05	0.27	0.22	0.22
	22	0.50	2.90	2.40	0.04	0.24	0.20	0.20
	23	0.50	2.90	2.40	0.04	0.21	0.18	0.18
	24	0.50	2.90	2.40	0.03	0.19	0.16	0.16
	25	0.50	2.90	2.40	0.03	0.17	0.14	0.14
	26	0.50	2.90	2.40	0.03	0.15	0.13	0.13
	27	0.50	2.90	2.40	0.02	0.14	0.11	0.11
	28	0.50	2.90	2.40	0.02	0.12	0.10	0.10
	29	0.50	2.90	2.40	0.02	0.11	0.09	0.09
	30	0.50	2.90	2.40	0.02	0.10	0.08	0.08
TOTAL		24.50	76.00	52.30	10.47	15.67	5.21	10.54

Net Present Worth	5.21
Internal Rate of Return	0.21
Benefit-Cost Ratio	1.50
Net Benefit Investment Ratio	1.98

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(3) We now move on to the "DISCOUNTED" section (Columns E, F and G). If we are careful, and have planned ahead, we can just define one cell (E14) and /Copy this cell to the rectangular area E14.G43. The secret is to put the "dollar signs" in the right place. ***The appropriate formula for cell E14 is:***

+B14/(1+$E$5)^$A14

Fill in the cell and /Copy this cell to the range E14.G13. Think and make sure you understand why the dollar signs are where they are.

(4) We will leave column H alone for now and tackle the TOTAL row (Row 45) first. ***Provide the formula for Cell B45 and /Copy it to the rest of the TOTAL row.*** Since we have not filled in Column H yet, Cell H45 should contain 0 instead of 10.54 as displayed in Figure 11.1. But this will fix itself later.

(5) We could use the @NPV formula to compute the NET PRESENT WORTH in Cell E47. But since it has already been computed in Cell G45, ***simply insert the cell reference:***

+G45

in Cell E47.

(6) ***The INTERNAL RATE OF RETURN in Cell E48 can be computed with the @IRR function in LOTUS. Use 0.2 as the "guess" value.*** (Refer back to lesson 9 if you have forgotten about the @IRR function).

(7) BENEFIT-COST RATIO in ***Cell E49*** is the quotient of the NPV of the INCREMENTAL BENEFIT column and NPV of the INCREMENTAL COST column. But these are already computed in Cell F45 and Cell E45, respectively. ***So insert in the correct formula now.***

(8) Now we will take on the NET BENEFIT INVESTMENT RATIO (N-K ratio) in Cell E50. First of all, the NET BENEFIT INVESTMENT RATIO is defined mathematically as:

$$\frac{\sum_{t=1}^{T}\left(\frac{N_t}{(1+i)^t}\right)}{\sum_{t=1}^{T}\left(\frac{K_t}{(1+i)^t}\right)}$$

where N_t is the incremental net benefit in each year after the stream has turned positive and K_t is the incremental net benefit in initial years when the stream is negative. In other words, it can be expressed as:

$$\frac{\text{NPV of POSITIVE NET BENEFITS ONLY}}{\text{NPV of NEGATIVE NET BENEFITS ONLY}}$$

and since NPV of NEGATIVE NET BENEFITS ONLY can be expressed as:

(NPV of NET BENEFITS) - (NPV of POSITIVE BENEFITS ONLY)

The N-K ratio can be expressed as:

$$\frac{\text{NPV of POSITIVE NET BENEFITS ONLY}}{\text{(NPV of NET BENEFITS) - (NPV of POSITIVE BENEFITS ONLY)}}$$

In order to calculate the NPV of POSITIVE BENEFITS ONLY, we need a series which contains the DISCOUNTED INCREMENTAL POSITIVE NET BENEFIT. Each element of this series is derived by inspecting the corresponding entry of the DISCOUNTED INCREMENTAL NET BENEFIT, if the entry is positive, then the element is just that entry, otherwise the element should be zero. This is what Column H is all about.

Column H can be derived by using the data in Column G and the @IF function in LOTUS. (If you have forgotten about the @IF function in LOTUS, refer to Lesson 9.) ***The appropriate entry in Cell H14 is:***

@IF(G14>0,G14,0)

which says that if G14 is greater than zero, then H14 should be equal to G14, otherwise G14 should be equal to 0. ***Enter this now and copy the formula down column H.***

Since H45 is the sum of column 6, it therefore is the NPV of POSITIVE BENEFITS ONLY. ***Thus the appropriate formula in Cell E50 is:***

+G50/(H50-G50)

Enter it.

We have now completed Figure 11.1. ***Save it under the name INDO1.***

Figure 11.2. Worksheet for Sensitivity Analysis of an Irrigation Project

Jatiluhur Irrigation Project
Indonesia

ASSUMPTION

Discount Factor:	0.12
% Cost Overrun	0.1
% Benefit Shortfall	0.15

	Most Probable Outcome							Alternative Outcome						
				DISCOUNTED							DISCOUNTED			
Year	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit
1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00	0.55	0.00	-0.55	0.49	0.00	-0.49	0.00
2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00	2.31	0.34	-1.97	1.84	0.27	-1.57	0.00
3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00	4.07	0.68	-3.39	2.90	0.48	-2.41	0.00
4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00	4.07	1.19	-2.88	2.59	0.76	-1.83	0.00
5	2.00	2.10	0.10	1.13	1.19	0.06	0.06	2.20	1.79	-0.42	1.25	1.01	-0.24	0.00
6	0.50	2.50	2.00	0.25	1.27	1.01	1.01	0.55	2.13	1.58	0.28	1.08	0.80	0.80
7	0.50	2.90	2.40	0.23	1.31	1.09	1.09	0.55	2.47	1.92	0.25	1.12	0.87	0.87
8	0.50	2.90	2.40	0.20	1.17	0.97	0.97	0.55	2.47	1.92	0.22	1.00	0.77	0.77
9	0.50	2.90	2.40	0.18	1.05	0.87	0.87	0.55	2.47	1.92	0.20	0.89	0.69	0.69
10	0.50	2.90	2.40	0.16	0.93	0.77	0.77	0.55	2.47	1.92	0.18	0.79	0.62	0.62
11	0.50	2.90	2.40	0.14	0.83	0.69	0.69	0.55	2.47	1.92	0.16	0.71	0.55	0.55
12	0.50	2.90	2.40	0.13	0.74	0.62	0.62	0.55	2.47	1.92	0.14	0.63	0.49	0.49
13	0.50	2.90	2.40	0.11	0.66	0.55	0.55	0.55	2.47	1.92	0.13	0.56	0.44	0.44
14	0.50	2.90	2.40	0.10	0.59	0.49	0.49	0.55	2.47	1.92	0.11	0.50	0.39	0.39
15	0.50	2.90	2.40	0.09	0.53	0.44	0.44	0.55	2.47	1.92	0.10	0.45	0.35	0.35
16	0.50	2.90	2.40	0.08	0.47	0.39	0.39	0.55	2.47	1.92	0.09	0.40	0.31	0.31
17	0.50	2.90	2.40	0.07	0.42	0.35	0.35	0.55	2.47	1.92	0.08	0.36	0.28	0.28
18	0.50	2.90	2.40	0.07	0.38	0.31	0.31	0.55	2.47	1.92	0.07	0.32	0.25	0.25
19	0.50	2.90	2.40	0.06	0.34	0.28	0.28	0.55	2.47	1.92	0.06	0.29	0.22	0.22
20	0.50	2.90	2.40	0.05	0.30	0.25	0.25	0.55	2.47	1.92	0.06	0.26	0.20	0.20
21	0.50	2.90	2.40	0.05	0.27	0.22	0.22	0.55	2.47	1.92	0.05	0.23	0.18	0.18
22	0.50	2.90	2.40	0.04	0.24	0.20	0.20	0.55	2.47	1.92	0.05	0.20	0.16	0.16
23	0.50	2.90	2.40	0.04	0.21	0.18	0.18	0.55	2.47	1.92	0.04	0.18	0.14	0.14
24	0.50	2.90	2.40	0.03	0.19	0.16	0.16	0.55	2.47	1.92	0.04	0.16	0.13	0.13
25	0.50	2.90	2.40	0.03	0.17	0.14	0.14	0.55	2.47	1.92	0.03	0.14	0.11	0.11
26	0.50	2.90	2.40	0.03	0.15	0.13	0.13	0.55	2.47	1.92	0.03	0.13	0.10	0.10
27	0.50	2.90	2.40	0.02	0.14	0.11	0.11	0.55	2.47	1.92	0.03	0.12	0.09	0.09
28	0.50	2.90	2.40	0.02	0.12	0.10	0.10	0.55	2.47	1.92	0.02	0.10	0.08	0.08
29	0.50	2.90	2.40	0.02	0.11	0.09	0.09	0.55	2.47	1.92	0.02	0.09	0.07	0.07
30	0.50	2.90	2.40	0.02	0.10	0.08	0.08	0.55	2.47	1.92	0.02	0.08	0.06	0.06
TOTAL	24.50	76.80	52.30	10.47	15.67	5.21	10.54	26.95	65.28	38.33	11.51	13.32	1.81	8.35
Net Present Worth				5.21							1.81			
Internal Rate of Return				0.21							0.15			
Benefit-Cost Ratio				1.50							1.16			
Net Benefit Investment Ratio				1.98							1.28			

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PROCEDURE FOR COMPLETION OF WORKSHEET IN FIGURE 11.2

(1) We are to develop the worksheet displayed in Figure 11.2 by performing "surgery" to the worksheet we have now. ***Before proceeding, inspect and compare Figures 11.1 and 11.2.*** The (visual) differences are as follows:

First, Figure 11.2 has two additional assumptions, namely % COST OVERRUN and % BENEFIT SHORTFALL. As a consequence, the cashflow table begins at row 9 instead of row 7.

Second, the cashflow table in Figure 11.2 contains two sections. The first section is the MOST PROBABLE OUTCOME, the second is ALTERNATIVE OUTCOME. The two sections are almost identical. The first section in Figure 11.2 is almost the same as Figure 11.1.

Third, since we have two sections in Figure 11.2, two additional rows are needed in the heading area to label the sections.

Let us elaborate on the difference between the two sections in more detail. We assume the MOST PROBABLE OUTCOME section is just the cashflow table which we completed before. The INCREMENTAL COST column of the ALTERNATIVE OUTCOME section is derived by the INCREMENTAL COST of the MOST PROBABLE OUTCOME, times one plus % COST OVERRUN. Similarly, the INCREMENTAL COST of the MOST PROBABLE OUTCOME is multiplied by 1 minus % BENEFIT SHORTFALL to arrive at the INCREMENTAL COST of the ALTERNATIVE OUTCOME. In other words, the ALTERNATIVE section answers the question: what if we have a x percent COST OVERRUN, and/or a y percent BENEFIT SHORTFALL, how would that affect our various discounted measures of project worth? Or equivalently, how sensitive are our discounted measures of project worth to underestimating the cost, or overestimating the benefits?

(2) In order to have room for the two additional assumptions, two rows must be inserted. ***To do so, position the cursor anywhere in Row 6, say Cell A6, then invoke***

/Worksheet Insert Row

when prompted for the rows to insert, press the down arrow key once to cover two rows (since we want to insert two rows), then press the enter key to initiate the insertion.

(3) ***Move the cursor to Cell B6 and enter in the label:***

% Cost Overrun

(4) ***Move the cursor to Cell B7 and enter in the label:***

% Benefit Shortfall

(5) ***Enter 0.1 and 0.15 in Cells E6 and E7 respectively.***

(6) Since the two sections of the table are very much the same both in appearance and contents, we can use the ***/Copy*** command to come up with the new section. ***Use the /Copy command to copy the range B9.H53 to the area beginning in Cell I9.***

(7) Now we will insert two additional rows in the table heading area in order to have room to put in the headings MOST PROBABLE OUTCOME and ALTERNATIVE OUTCOME. ***To do so, position the cursor anywhere in Row 10, then invoke:***

/Worksheet Insert Row

Then expand the highlighted area downwards by pressing the down arrow key once so that the cursor has a height of two rows. Then press the enter key.

(8) Now you have room to ***put in the two new headings in Cells D10 and K10. Do so now.***

(9) Before changing the formulas, let's get the column width correctly. ***Columns I and L should be set to column widths of 10. Whereas columns J, K, M, N and O should be set to widths of 8.*** This is consistent with the original cashflow table. (Copying with the /Copy command does not also copy the column width). To set the column width of a column, position the cursor anywhere in the column and use the /Column Set-width command.

(10) Now we are ready to adjust the formulas in the INCREMENTAL COST and INCREMENTAL BENEFIT columns of the ALTERNATIVE OUTCOME SECTION to reflect the COST OVERRUN and BENEFIT SHORTFALL.

In Cell I18, insert the formula:

+E18*(1+$E$6)

The formula says that the INCREMENTAL COST of the ALTERNATIVE SCENARIO is the value in cell $E$6 percent more than that of the MOST PROBABLE SCENARIO.

Then in Cell J18, insert the formula:

+F18*(1-$E$7)

These two formulas can then be /Copy'ed down the Columns I and J.

(11) If you were following our procedure closely, no other formula need be adjusted. To check, insert 0's in cell E6 and E7 and see if the two OUTCOMES yield the same answer. Then change the numbers back to .1 and .15 respectively.

CONSTRUCTING A ONE-WAY DATA TABLE FOR SENSITIVITY ANALYSIS

(1) The reason we have worked so hard to put formulas in the worksheet is so that we can ask what if questions. For example, we might ask: "What if the % COST OVERRUN is 20%? How would that affect the various discounted measures of project worth?" To answer this question, you would simply change cell E6 to .20, LOTUS would then almost instantaneously recalculate the entire worksheet given this changed assumption. You could repeat this for values of % COST OVERRUN of, say, .25, .30, and .35 and so on.

LOTUS contains a much more powerful "what-if" capability than this "try and see" approach. You can give LOTUS an entire list of what-if entries at once, along with formulas that depend on these entries, directly or indirectly. IN A SINGLE STEP, LOTUS creates a table showing how the value(s) of the formula(s) changes when the values affect one formula. This facility is called DATA TABLE.

(2) The DATA TABLE facilities of LOTUS seem overwhelming at first, but it comes with practice and is well worth the effort for mastering. Two kinds of DATA TABLES are allowed with LOTUS, the first of which is called DATA TABLE 1, where we can see the effect of changes in ONE assumption cell, say % COST OVERRUN, at a time, assuming that the other assumption cells remained unchanged. The second kind of DATA TABLE, DATA TABLE 2, allows you to see the effect of changes in TWO assumptions cells simultaneously, where other assumption cells remained unchanged. You can have as many DATA TABLES in your worksheet as you want.

(3) To demonstrate the DATA TABLE 1 facility, ***first type the information cells Q14 through U18 and the data in Column Q in the table as displayed in Figure 11.3. Don't type in the area R19 to U27 since this will be automatically filled in by LOTUS.***

While you are typing in R18 to U18, numbers instead of formulas will be displayed. To display formulas "as is", this range R18 to U18 should be formatted with the /Range Format Text command. Notice that these cell entries (+L51, +L52, +L53, +L54) are simply cell references to the NET PRESENT WORTH, INTERNAL RATE OF RETURN, BENEFIT-COST RATIO, and NET BENEFIT INVESTMENT RATIO cells in our worksheet. The Data Table command will simply insert the cost overrun value in Column Q into Cell E6, recalculate the worksheet, and copy the results from Cells L51 through L54 into our output table.

(4) The numbers in column Q are simply % COST OVERRUNS. Our objective is to see the effects on NPW, IRR, BC and NK as % COST OVERRUN varies from 0 to .40 in steps of .05.

Figure 11.3. Application of Data Table 1 Technique for Summarizing Effects of Alternative Cost Overruns on Project Viability

	Q	R	S	T	U
14	%				
15	Cost				
16	Overrun	NPW	IRR	BC	NK
17					
18		+L51	+L52	+L53	+L54
19	0.00	2.86	0.17	1.27	1.50
20	0.05	2.33	0.16	1.21	1.38
21	0.10	1.81	0.15	1.16	1.28
22	0.15	1.29	0.14	1.11	1.19
23	0.20	0.76	0.13	1.06	1.10
24	0.25	0.24	0.12	1.02	1.03
25	0.30	-0.28	0.12	0.98	0.97
26	0.35	-0.81	0.11	0.94	0.91
27	0.40	-1.33	0.10	0.91	0.85
28					

(5) ***Now move the cursor to cell Q18 and invoke the /Data Table 1 command. When prompt for the table range, press . and expand the cursor to cover the area Q18 to U27.*** Note that the Data Table Area is just Q18 to U27, the rest is simply window dressing.

(6) ***When prompted for input cell 1, specify E6.*** This is the cell where the %COST OVERRUN resides in our worksheet.

(7) Then just sit back and watch, the table should be filled up as displayed in Figure 11.3.

(8) EXERCISE: To test your understanding of the above process. Construct a similar table for % BENEFIT SHORT FALL starting at location Q31.

(9) ***Save this worksheet under the name INDO2.***

In the next lesson, we will implement BENEFIT DELAY in this worksheet and cover DATA TABLE 2.

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Lesson 12

EVALUATION OF AGRICULTURAL PROJECTS USING LOTUS 1-2-3

Part IV

Prepared by Elton Li, Dean Schreiner and Art Stoecker

OBJECTIVES

This is a continuation of lesson 11. We will begin with the INDO2 worksheet completed in Lesson 12, and add a BENEFIT DELAY parameter. In addition, we will demonstrate how sensitivity analysis can be performed using the 2-WAY DATA TABLE facility of LOTUS. The choose function in Lotus will be used to parametertize benefit delays.

References: Schreiner, D.F. "Agricultural Project Investment Analysis," Chapter 10 and "Policy Applications in Natural Resource Projects," Chapter 11, *Agricultural Policy Analysis Tools for Economic Development.*

O'Leary, T.J. "Data Table Commands and Choose Function." *The Student Edition of Lotus 1-2-3,* Addison-Wesley, New York.

Gittenger, J.P. *Economic Analysis of Agricultural Projects.* John Hopkins University Press, 1982.

Ewing, D.P. and D.F. Noble. *Using 1-2-3, Special Edition.* Que Corp., Carmel, Ind., 1987.

PARAMETERIZING BENEFIT DELAY

Introduction

Delays in implementation (and hence delays in receiving project benefits) affect many agricultural projects. There are many reasons for delays in project implementation. We might have underestimated the technical difficulties or time required for farmers to adopt or master new practices or techniques. There may be delays in ordering and receiving new equipment. Delays may also be caused by government "red tape". Testing to determine the effects of delay on the net present worth, the financial and economic rates of return, and the net benefit-investment ratio, etc., of a proposed agricultural investment is an important part of sensitivity analysis.

Procedure

(1) ***Start up LOTUS as usual. Load up the last worksheet you completed in Lesson 11, namely INDO2.***

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Figure 12.1. Worksheet for Sensitivity Analysis of an Irrigation Project (from Lesson 11)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Jatiluhur Irrigation Project														
2	Indonesia														
3															
4	ASSUMPTION														
5	Discount Factor:				0.12										
6	% Cost Overrun				0										
7	% Benefit Shortfall				0										
8															
9															
10		Most Probable Outcome							Alternative Outcome						
11															
12					DISCOUNTED							DISCOUNTED			
13															
14		Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-	Incr-
15		mental	mental	mental	mental	mental	mental	mental	mental	mental	mental	mental	mental	mental	mental
16	Year	Cost	Benefit	Net Benefit	Cost	Benefit	Net Benefit	+ve Net Benefit	Cost	Benefit	Net Benefit	Cost	Benefit	Net Benefit	+ve Net Benefit
17															
18	1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00
19	2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00
20	3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00
21	4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00
22	5	2.00	2.10	0.10	1.13	1.19	0.06	0.06	2.00	2.10	0.10	1.13	1.19	0.06	0.06
23	6	0.50	2.50	2.00	0.25	1.27	1.01	1.01	0.50	2.50	2.00	0.25	1.27	1.01	1.01
24	7	0.50	2.90	2.40	0.23	1.31	1.09	1.09	0.50	2.90	2.40	0.23	1.31	1.09	1.09
25	8	0.50	2.90	2.40	0.20	1.17	0.97	0.97	0.50	2.90	2.40	0.20	1.17	0.97	0.97
26	9	0.50	2.90	2.40	0.18	1.05	0.87	0.87	0.50	2.90	2.40	0.18	1.05	0.87	0.87
27	10	0.50	2.90	2.40	0.16	0.93	0.77	0.77	0.50	2.90	2.40	0.16	0.93	0.77	0.77
28	11	0.50	2.90	2.40	0.14	0.83	0.69	0.69	0.50	2.90	2.40	0.14	0.83	0.69	0.69
29	12	0.50	2.90	2.40	0.13	0.74	0.62	0.62	0.50	2.90	2.40	0.13	0.74	0.62	0.62
30	13	0.50	2.90	2.40	0.11	0.66	0.55	0.55	0.50	2.90	2.40	0.11	0.66	0.55	0.55
31	14	0.50	2.90	2.40	0.10	0.59	0.49	0.49	0.50	2.90	2.40	0.10	0.59	0.49	0.49
32	15	0.50	2.90	2.40	0.09	0.53	0.44	0.44	0.50	2.90	2.40	0.09	0.53	0.44	0.44
33	16	0.50	2.90	2.40	0.08	0.47	0.39	0.39	0.50	2.90	2.40	0.08	0.47	0.39	0.39
34	17	0.50	2.90	2.40	0.07	0.42	0.35	0.35	0.50	2.90	2.40	0.07	0.42	0.35	0.35
35	18	0.50	2.90	2.40	0.07	0.38	0.31	0.31	0.50	2.90	2.40	0.07	0.38	0.31	0.31
36	19	0.50	2.90	2.40	0.06	0.34	0.28	0.28	0.50	2.90	2.40	0.06	0.34	0.28	0.28
37	20	0.50	2.90	2.40	0.05	0.30	0.25	0.25	0.50	2.90	2.40	0.05	0.30	0.25	0.25
38	21	0.50	2.90	2.40	0.05	0.27	0.22	0.22	0.50	2.90	2.40	0.05	0.27	0.22	0.22
39	22	0.50	2.90	2.40	0.04	0.24	0.20	0.20	0.50	2.90	2.40	0.04	0.24	0.20	0.20
40	23	0.50	2.90	2.40	0.04	0.21	0.18	0.18	0.50	2.90	2.40	0.04	0.21	0.18	0.18
41	24	0.50	2.90	2.40	0.03	0.19	0.16	0.16	0.50	2.90	2.40	0.03	0.19	0.16	0.16
42	25	0.50	2.90	2.40	0.03	0.17	0.14	0.14	0.50	2.90	2.40	0.03	0.17	0.14	0.14
43	26	0.50	2.90	2.40	0.03	0.15	0.13	0.13	0.50	2.90	2.40	0.03	0.15	0.13	0.13
44	27	0.50	2.90	2.40	0.02	0.14	0.11	0.11	0.50	2.90	2.40	0.02	0.14	0.11	0.11
45	28	0.50	2.90	2.40	0.02	0.12	0.10	0.10	0.50	2.90	2.40	0.02	0.12	0.10	0.10
46	29	0.50	2.90	2.40	0.02	0.11	0.09	0.09	0.50	2.90	2.40	0.02	0.11	0.09	0.09
47	30	0.50	2.90	2.40	0.02	0.10	0.08	0.08	0.50	2.90	2.40	0.02	0.10	0.08	0.08
48															
49	TOTAL	24.50	76.80	52.30	10.47	15.67	5.21	10.54	24.50	76.80	52.30	10.47	15.67	5.21	10.54
50															
51	Net Present Worth				5.21							5.21			
52	Internal Rate of Return				0.21							0.21			
53	Benefit-Cost Ratio				1.50							1.50			
54	Net Benefit Investment Ratio				1.98							1.98			
55															
56															

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(2) ***Change the assumptions to 0 % COST OVERRUN and 0 % BENEFIT SHORTFALL.*** In other words, the alternative outcome session is set to be the same as the most probable outcome session. Your worksheet should now be as displayed in Figure 12.1.

Column J is the INCREMENTAL BENEFIT of the ALTERNATIVE OUTCOME section. Values for the first 5 years are: 0.00, 0.40, 0.80, 1.40 and 2.10. If the return of the benefits were delayed for one year for the ALTERNATIVE OUTCOME, then the 1st year's BENEFIT of the MOST PROBABLE OUTCOME would become the 2nd year's BENEFIT for the ALTERNATIVE OUTCOME (i.e. delayed for 1 year). Similarly, ALTERNATIVE OUTCOME's NET BENEFIT for year 3 is simply MOST PROBABLE OUTCOME's NET BENEFIT of year 2. In other words, if BENEFIT DELAY is 1, then Column J should be column C "lagged" one year.

Now move to Cell J19 and look at the formula there. Cell J19 should be derived from Cell C19, taken into account % BENEFIT SHORTFALL:

C19*(1-$E$7)

If the realization of benefits is delayed one year (BENEFIT DELAY=1), then instead of referencing INCREMENTAL BENEFIT of the MOST PROBABLE OUTCOME of the same year, we should reference the one for last year, thus the appropriate formula for ***Cell J19*** should be instead:

C18*(1-$E$7)

Put this formula in now. Then /Copy this formula down Column J.

What about Cell J18? ***Move the cursor to cell J18*** and look at the formula there. We have not changed this formula yet, it should still be:

C18*(1-$E$7)

which happens to have a value of zero since C18 is zero. But we want this cell to always be zero, since the "last year" of year 1 is year 0, which is not in the analysis. ***The only way to ensure this is to actually insert a zero in this cell. Do it now.*** Your worksheet should now be identical to Figure 12.2. The worksheet shows that, among other things, IRR has dropped 4% to 0.17.

(3) **EXERCISE**: ***Implement a 2 year BENEFIT DELAY. The resulting worksheet should be the same as Figure 12.3.***

(4) Parameterizing BENEFIT DELAY. Instead of having to alter the formulas of the worksheet for every BENEFIT DELAY value, one can instead "parameterize" BENEFIT DELAY into the analysis. This is shown in Figure 12.4.

By parameterizing BENEFIT DELAY, we mean that we wish to put BENEFIT DELAY into the ASSUMPTION section, as shown in Cell E8 in Figure 12.4. To look at the effect of a BENEFIT DELAY of 3, one only need to insert a 3 in cell E8. Or alternatively, if one wish to inspect the effect of a BENEFIT DELAY of 6, E8 can be changed to 6. The rest of the worksheet should AUTOMATICALLY adjusts to this change of assumption.

Figure 12.2. Analysis of the Jatiluhur Irrigation Project With a One-Year Benefit Delay

Jatiluhur Irrigation Project
Indonesia

ASSUMPTION

Discount Factor:	0.12
% Cost Overrun	0
% Benefit Shortfall	0

	Most Probable Outcome							Alternative Outcome						
				DISCOUNTED							DISCOUNTED			
Year	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit
1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00
2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00	2.10	0.00	-2.10	1.67	0.00	-1.67	0.00
3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00	3.70	0.40	-3.30	2.63	0.28	-2.35	0.00
4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00	3.70	0.80	-2.90	2.35	0.51	-1.84	0.00
5	2.00	2.10	0.10	1.13	1.19	0.06	0.06	2.00	1.40	-0.60	1.13	0.79	-0.34	0.00
6	0.50	2.50	2.00	0.25	1.27	1.01	1.01	0.50	2.10	1.60	0.25	1.06	0.81	0.81
7	0.50	2.90	2.40	0.23	1.31	1.09	1.09	0.50	2.50	2.00	0.23	1.13	0.90	0.90
8	0.50	2.90	2.40	0.20	1.17	0.97	0.97	0.50	2.90	2.40	0.20	1.17	0.97	0.97
9	0.50	2.90	2.40	0.18	1.05	0.87	0.87	0.50	2.90	2.40	0.18	1.05	0.87	0.87
10	0.50	2.90	2.40	0.16	0.93	0.77	0.77	0.50	2.90	2.40	0.16	0.93	0.77	0.77
11	0.50	2.90	2.40	0.14	0.83	0.69	0.69	0.50	2.90	2.40	0.14	0.83	0.69	0.69
12	0.50	2.90	2.40	0.13	0.74	0.62	0.62	0.50	2.90	2.40	0.13	0.74	0.62	0.62
13	0.50	2.90	2.40	0.11	0.66	0.55	0.55	0.50	2.90	2.40	0.11	0.66	0.55	0.55
14	0.50	2.90	2.40	0.10	0.59	0.49	0.49	0.50	2.90	2.40	0.10	0.59	0.49	0.49
15	0.50	2.90	2.40	0.09	0.53	0.44	0.44	0.50	2.90	2.40	0.09	0.53	0.44	0.44
16	0.50	2.90	2.40	0.08	0.47	0.39	0.39	0.50	2.90	2.40	0.08	0.47	0.39	0.39
17	0.50	2.90	2.40	0.07	0.42	0.35	0.35	0.50	2.90	2.40	0.07	0.42	0.35	0.35
18	0.50	2.90	2.40	0.07	0.38	0.31	0.31	0.50	2.90	2.40	0.07	0.38	0.31	0.31
19	0.50	2.90	2.40	0.06	0.34	0.28	0.28	0.50	2.90	2.40	0.06	0.34	0.28	0.28
20	0.50	2.90	2.40	0.05	0.30	0.25	0.25	0.50	2.90	2.40	0.05	0.30	0.25	0.25
21	0.50	2.90	2.40	0.05	0.27	0.22	0.22	0.50	2.90	2.40	0.05	0.27	0.22	0.22
22	0.50	2.90	2.40	0.04	0.24	0.20	0.20	0.50	2.90	2.40	0.04	0.24	0.20	0.20
23	0.50	2.90	2.40	0.04	0.21	0.18	0.18	0.50	2.90	2.40	0.04	0.21	0.18	0.18
24	0.50	2.90	2.40	0.03	0.19	0.16	0.16	0.50	2.90	2.40	0.03	0.19	0.16	0.16
25	0.50	2.90	2.40	0.03	0.17	0.14	0.14	0.50	2.90	2.40	0.03	0.17	0.14	0.14
26	0.50	2.90	2.40	0.03	0.15	0.13	0.13	0.50	2.90	2.40	0.03	0.15	0.13	0.13
27	0.50	2.90	2.40	0.02	0.14	0.11	0.11	0.50	2.90	2.40	0.02	0.14	0.11	0.11
28	0.50	2.90	2.40	0.02	0.12	0.10	0.10	0.50	2.90	2.40	0.02	0.12	0.10	0.10
29	0.50	2.90	2.40	0.02	0.11	0.09	0.09	0.50	2.90	2.40	0.02	0.11	0.09	0.09
30	0.50	2.90	2.40	0.02	0.10	0.08	0.08	0.50	2.90	2.40	0.02	0.10	0.08	0.08
TOTAL	24.50	76.80	52.30	10.47	15.67	5.21	10.54	24.50	73.90	49.40	10.47	13.91	3.44	10.09

Net Present Worth	5.21		3.44
Internal Rate of Return	0.21		0.17
Benefit-Cost Ratio	1.50		1.33
Net Benefit Investment Ratio	1.98		1.52

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Figure 12.3. Analysis of the Jatiluhur Irrigation Projects With a Two-Year Benefit Delay

Jatiluhur Irrigation Project
Indonesia

ASSUMPTION

Discount Factor:	0.12
% Cost Overrun	0
% Benefit Shortfall	0

	Most Probable Outcome							Alternative Outcome						
				DISCOUNTED							DISCOUNTED			
Year	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit
1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00
2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00	2.10	0.00	-2.10	1.67	0.00	-1.67	0.00
3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00	3.70	0.00	-3.70	2.63	0.00	-2.63	0.00
4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00	3.70	0.40	-3.30	2.35	0.25	-2.10	0.00
5	2.00	2.10	0.10	1.13	1.19	0.06	0.06	2.00	0.80	-1.20	1.13	0.45	-0.68	0.00
6	0.50	2.50	2.00	0.25	1.27	1.01	1.01	0.50	1.40	0.90	0.25	0.71	0.46	0.46
7	0.50	2.90	2.40	0.23	1.31	1.09	1.09	0.50	2.10	1.60	0.23	0.95	0.72	0.72
8	0.50	2.90	2.40	0.20	1.17	0.97	0.97	0.50	2.50	2.00	0.20	1.01	0.81	0.81
9	0.50	2.90	2.40	0.18	1.05	0.87	0.87	0.50	2.90	2.40	0.18	1.05	0.87	0.87
10	0.50	2.90	2.40	0.16	0.93	0.77	0.77	0.50	2.90	2.40	0.16	0.93	0.77	0.77
11	0.50	2.90	2.40	0.14	0.83	0.69	0.69	0.50	2.90	2.40	0.14	0.83	0.69	0.69
12	0.50	2.90	2.40	0.13	0.74	0.62	0.62	0.50	2.90	2.40	0.13	0.74	0.62	0.62
13	0.50	2.90	2.40	0.11	0.66	0.55	0.55	0.50	2.90	2.40	0.11	0.66	0.55	0.55
14	0.50	2.90	2.40	0.10	0.59	0.49	0.49	0.50	2.90	2.40	0.10	0.59	0.49	0.49
15	0.50	2.90	2.40	0.09	0.53	0.44	0.44	0.50	2.90	2.40	0.09	0.53	0.44	0.44
16	0.50	2.90	2.40	0.08	0.47	0.39	0.39	0.50	2.90	2.40	0.08	0.47	0.39	0.39
17	0.50	2.90	2.40	0.07	0.42	0.35	0.35	0.50	2.90	2.40	0.07	0.42	0.35	0.35
18	0.50	2.90	2.40	0.07	0.38	0.31	0.31	0.50	2.90	2.40	0.07	0.38	0.31	0.31
19	0.50	2.90	2.40	0.06	0.34	0.28	0.28	0.50	2.90	2.40	0.06	0.34	0.28	0.28
20	0.50	2.90	2.40	0.05	0.30	0.25	0.25	0.50	2.90	2.40	0.05	0.30	0.25	0.25
21	0.50	2.90	2.40	0.05	0.27	0.22	0.22	0.50	2.90	2.40	0.05	0.27	0.22	0.22
22	0.50	2.90	2.40	0.04	0.24	0.20	0.20	0.50	2.90	2.40	0.04	0.24	0.20	0.20
23	0.50	2.90	2.40	0.04	0.21	0.18	0.18	0.50	2.90	2.40	0.04	0.21	0.18	0.18
24	0.50	2.90	2.40	0.03	0.19	0.16	0.16	0.50	2.90	2.40	0.03	0.19	0.16	0.16
25	0.50	2.90	2.40	0.03	0.17	0.14	0.14	0.50	2.90	2.40	0.03	0.17	0.14	0.14
26	0.50	2.90	2.40	0.03	0.15	0.13	0.13	0.50	2.90	2.40	0.03	0.15	0.13	0.13
27	0.50	2.90	2.40	0.02	0.14	0.11	0.11	0.50	2.90	2.40	0.02	0.14	0.11	0.11
28	0.50	2.90	2.40	0.02	0.12	0.10	0.10	0.50	2.90	2.40	0.02	0.12	0.10	0.10
29	0.50	2.90	2.40	0.02	0.11	0.09	0.09	0.50	2.90	2.40	0.02	0.11	0.09	0.09
30	0.50	2.90	2.40	0.02	0.10	0.08	0.08	0.50	2.90	2.40	0.02	0.10	0.08	0.08
TOTAL	74.50	76.80	52.30	10.47	15.67	5.21	10.54	24.50	71.00	46.50	10.47	12.33	1.87	9.40

Net Present Worth	5.21			1.87	
Internal Rate of Return	0.21			0.14	
Benefit-Cost Ratio	1.50			1.18	
Net Benefit Investment Ratio	1.98			1.25	

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Figure 12.4. Jatiluhur Irrigation Project With Parameterized Benefit Delay

Jatiluhur Irrigation Project
Indonesia

ASSUMPTION

Discount Factor:	0.12
% Cost Overrun	0
% Benefit Shortfall	0
Benefit Delay (0-6)	6

	Most Probable Outcome							Alternative Outcome						
					DISCOUNTED							DISCOUNTED		
Year	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Cost	Incr-mental Benefit	Incr-mental Net Benefit	Incr-mental Pos Net Benefit
1	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00	0.50	0.00	-0.50	0.45	0.00	-0.45	0.00
2	2.10	0.40	-1.70	1.67	0.32	-1.36	0.00	2.10	0.00	-2.10	1.67	0.00	-1.67	0.00
3	3.70	0.80	-2.90	2.63	0.57	-2.06	0.00	3.70	0.00	-3.70	2.63	0.00	-2.63	0.00
4	3.70	1.40	-2.30	2.35	0.89	-1.46	0.00	3.70	0.00	-3.70	2.35	0.00	-2.35	0.00
5	2.00	2.10	0.10	1.13	1.19	0.06	0.06	2.00	0.00	-2.00	1.13	0.00	-1.13	0.00
6	0.50	2.50	2.00	0.25	1.27	1.01	1.01	0.50	0.00	-0.50	0.25	0.00	-0.25	0.00
7	0.50	2.90	2.40	0.23	1.31	1.09	1.09	0.50	0.00	-0.50	0.23	0.00	-0.23	0.00
8	0.50	2.90	2.40	0.20	1.17	0.97	0.97	0.50	0.40	-0.10	0.20	0.16	-0.04	0.00
9	0.50	2.90	2.40	0.18	1.05	0.87	0.87	0.50	0.80	0.30	0.18	0.29	0.11	0.11
10	0.50	2.90	2.40	0.16	0.93	0.77	0.77	0.50	1.40	0.90	0.16	0.45	0.29	0.29
11	0.50	2.90	2.40	0.14	0.83	0.69	0.69	0.50	2.10	1.60	0.14	0.60	0.46	0.46
12	0.50	2.90	2.40	0.13	0.74	0.62	0.62	0.50	2.50	2.00	0.13	0.64	0.51	0.51
13	0.50	2.90	2.40	0.11	0.66	0.55	0.55	0.50	2.90	2.40	0.11	0.66	0.55	0.55
14	0.50	2.90	2.40	0.10	0.59	0.49	0.49	0.50	2.90	2.40	0.10	0.59	0.49	0.49
15	0.50	2.90	2.40	0.09	0.53	0.44	0.44	0.50	2.90	2.40	0.09	0.53	0.44	0.44
16	0.50	2.90	2.40	0.08	0.47	0.39	0.39	0.50	2.90	2.40	0.08	0.47	0.39	0.39
17	0.50	2.90	2.40	0.07	0.42	0.35	0.35	0.50	2.90	2.40	0.07	0.42	0.35	0.35
18	0.50	2.90	2.40	0.07	0.38	0.31	0.31	0.50	2.90	2.40	0.07	0.38	0.31	0.31
19	0.50	2.90	2.40	0.06	0.34	0.28	0.28	0.50	2.90	2.40	0.06	0.34	0.28	0.28
20	0.50	2.90	2.40	0.05	0.30	0.25	0.25	0.50	2.90	2.40	0.05	0.30	0.25	0.25
21	0.50	2.90	2.40	0.05	0.27	0.22	0.22	0.50	2.90	2.40	0.05	0.27	0.22	0.22
22	0.50	2.90	2.40	0.04	0.24	0.20	0.20	0.50	2.90	2.40	0.04	0.24	0.20	0.20
23	0.50	2.90	2.40	0.04	0.21	0.18	0.18	0.50	2.90	2.40	0.04	0.21	0.18	0.18
24	0.50	2.90	2.40	0.03	0.19	0.16	0.16	0.50	2.90	2.40	0.03	0.19	0.16	0.16
25	0.50	2.90	2.40	0.03	0.17	0.14	0.14	0.50	2.90	2.40	0.03	0.17	0.14	0.14
26	0.50	2.90	2.40	0.03	0.15	0.13	0.13	0.50	2.90	2.40	0.03	0.15	0.13	0.13
27	0.50	2.90	2.40	0.02	0.14	0.11	0.11	0.50	2.90	2.40	0.02	0.14	0.11	0.11
28	0.50	2.90	2.40	0.02	0.12	0.10	0.10	0.50	2.90	2.40	0.02	0.12	0.10	0.10
29	0.50	2.90	2.40	0.02	0.11	0.09	0.09	0.50	2.90	2.40	0.02	0.11	0.09	0.09
30	0.50	2.90	2.40	0.02	0.10	0.08	0.08	0.50	2.90	2.40	0.02	0.10	0.08	0.08
TOTAL	24.50	76.80	52.30	10.47	15.67	5.21	10.54	24.50	59.40	34.90	10.47	7.54	-2.92	5.84

Net Present Worth	5.21	-2.92
Internal Rate of Return	0.21	0.09
Benefit-Cost Ratio	1.50	0.72
Net Benefit Investment Ratio	1.98	0.67

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To arrive at the worksheet in Figure 12.4, first we would need an additional row for the new assumption. ***To do so, first position the cursor anywhere in Row 8, then invoke the /Worksheet Insert Row command. Notice that this command inserts the row above the cursor. Thus Row 8 is now new and what used to be row 8 now becomes Row 9, and what used to be Row 9 now becomes Row 10 and so on.***

Now in cell B8, insert the label:

Benefit Delay (0-6)

Then insert the value 6 in Cell E8.

(5) ***Now we need to modify the formula. First move to Cell J25 and insert the formula:***

@CHOOSE($E$8,C25,C24,C23,C22,C21,C20,C19)*(1-$E$7)

In general, the @CHOOSE function has the form:

@CHOOSE(x,V0,V1,...,Vn)

If the value of x (the 1st argument) is 0, then @CHOOSE returns the value of V0 (the 2nd argument). If x is 1, then the value of V1 (the 3rd argument) is returned. If x is 2, the value of V2 (the 4th argument) is returned, and so on. In the formula here, x is $E$8, the BENEFIT DELAY parameter. If $E$8 is zero, then C25 is "chosen". In other words, the MOST PROBABLE OUTCOME's NET BENEFIT of the same year is chosen, since there is no BENEFIT DELAY. If $E$8 is 1, then C24 is "chosen" (C24 is last year's NET BENEFIT of the MOST PROBABLE OUTCOME). Similarly, when $E$8 is 2, 3, 4, 5 or 6, then respectively Cells C23, C22, C21, C20 and C19 are "chosen" or returned by the @CHOOSE function. After we had picked the right NET BENEFIT, we multiply it by (1-$E$7) to adjust for % BENEFIT SHORTFALL.

(6) ***After inserting the formula in Cell J25, use the /Copy command to copy the formula to the range J19.J48.*** We will explain and fix the ERR's later.

(7) Now we need to adjust the formula in column J for the first 6 years. To understand why we need to adjust the formula, ***move the cursor to cell J24,*** it should now contain the formula:

@CHOOSE($E$8,C24,C23,C22,C21,C20,C19,C18)*(1-$E$7)

Note that a reference to Cell C18 is made. What is in Cell C18? A dashed line. When BENEFIT DELAY is 6, instead of referencing Cell C18 we should instead insert a zero. ***Thus the formula in this cell should be adjusted to:***

@CHOOSE($E$8,C24,C23,C22,C21,C20,C19,0)*(1-$E$7)

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Similarly, the formulas in cells J23, J22, J21, J20 and J19 should respectively be adjusted to:

@CHOOSE($E$8,C23,C22,C21,C20,C19,0,0)*(1-$E$7)

@CHOOSE($E$8,C22,C21,C20,C19,0,0,0)*(1-$E$7)

@CHOOSE($E$8,C21,C20,C19,0,0,0,0)*(1-$E$7)

@CHOOSE($E$8,C20,C19,0,0,0,0,0)*(1-$E$7)

and

@CHOOSE($E$8,C19,0,0,0,0,0,0)*(1-$E$7)

These adjustments can easily be made using the F2 key. Make sure you understand why these adjustments are necessary. The complete worksheet should be identical to the one displayed in Figure 12.4.

(8) ***Save the worksheet under the name INDO3.***

CONSTRUCTING A TWO-WAY DATA TABLE

Figure 12.5 shows a two way data table for analysis of the joint effect of % BENEFIT SHORTFALL and BENEFIT DELAY on NPW (Net Present Worth of the project). The BENEFIT DELAY parameter values are listed across the table whereas the % BENEFIT SHORTFALL parameter values are listed down the left edge of the table. The location of the output variable is specified in the top left hand corner of the body of the table, namely cell X19. We have specified this location to be Cell L52, which contains NPW of the Alternative Outcome. We may have only one output variable in each two-way table. COST OVERRUN is assumed to be zero since Cell E6 contains 0.

The table shows that even with no % BENEFIT SHORTFALL, NPW of the project (at 12% discount rate) would fall below 0 if BENEFITS were DELAYED 4 years. With % BENEFIT SHORTFALL of 0.25, NPW would fall below 0 with only 1 year of BENEFIT delay.

The two-way data table differs from the one-way table in that we are allowed to analyze the effect of changes in two assumptions jointly. Whereas in the one-way table, only the effect of changes in one assumption can be analyzed. As a trade-off, in the one-way table we can display more that one output variable: in the one-way table we constructed in the previous lesson, the output variables are NPW, IRR, B-C ratio, and N-K ratio. But in the two-way table, only one output variable is allowed. The output variable we have here is NPV, or Cell L52. This formula, +L52, is coded into Cell X19. To look at the effect to another output variable, a different table must be constructed.

Procedure

(1) To implement the table, ***first type in the table as shown in Figure 12.5. Do not type in the area Y20 to AE28.***

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Figure 12.5. Application of the Data Table 2 Procedure for Summarizing Effects of Changing Two Parameters on the Net Present Worth of an Irrigation Project

	X	Y	Z	AA	AB	AC	AD	AE
14								
15				NPW with no cost overrun				
16	% Benefit							
17	Shortfall				Benefit Delay (Years)			
18								
19	+055	0	1	2	3	4	5	6
20	0.00	5.21	3.44	1.87	0.46	-0.80	-1.92	-2.92
21	0.05	4.42	2.75	1.25	-0.09	-1.28	-2.35	-3.30
22	0.10	3.64	2.05	0.63	-0.63	-1.77	-2.78	-3.68
23	0.15	2.86	1.36	0.02	-1.18	-2.25	-3.20	-4.05
24	0.20	2.07	0.66	-0.60	-1.73	-2.73	-3.63	-4.43
25	0.25	1.29	-0.04	-1.22	-2.27	-3.22	-4.06	-4.81
26	0.30	0.51	-0.73	-1.83	-2.82	-3.70	-4.48	-5.19
27	0.35	-0.28	-1.43	-2.45	-3.37	-4.18	-4.91	-5.56
28	0.40	-1.06	-2.12	-3.07	-3.91	-4.67	-5.34	-5.94

(2) ***Cell X19 is the "output variable" of this sensitivity analysis. This should be formatted with the /Range Format Text command.***

(3) ***Now position the cursor at cell X19 and invoke /Data Table 2.***

(4) ***You should specify the table range to be X19.AE28.*** Note that the body of the table should not include the labels or "window dressing."

(5) ***The Input Cell 1 should be the input cell relating to the assumptions listed down the left edge of the table. In this case it should be % BENEFIT SHORTFALL. The location of the parameter is in Cell E7.***

(6) ***Input Cell 2 is the input cell relating to the assumptions listed across the top of the table. In this case it should be BENEFIT DELAY. The location of the parameter is in Cell E8.***

(7) Wait for a few minutes for the computer to complete the computations. Format your table so that it appears as in Figure 12.5.

EXERCISE

(1) Starting at location X31, construct a 2-way data table similar to Figure 12.5 but with the BENEFIT-COST ratio as the output variable.

(2) Starting at location X49, construct a 2-way data table with parameter (input cell) 1 being the % BENEFIT SHORTFALL, parameter 2 being % COST OVERRUN. BENEFIT DELAY is assumed constant at 0. The output variable (cell) we would like to look at is NPW. Both parameters should range from 0 to 0.40 with increments of 0.05.

Lesson 16

MATRIX AND REGRESSION FACILITIES OF LOTUS

Prepared by E. Li, D. Ray and A. Stoecker

OBJECTIVE

This lesson aims to introduce the matrix and regression facilities of Lotus 1-2-3. Specific commands used are the Data/Matrix and Data/Regression commands. We will perform a multiple regression in two ways. First, we will demonstrate the actual matrix manipulation commands in Lotus to arrive at the beta estimates using the formula:

$$B=(X'X)^{-1}X'Y$$

Next we will use the more direct Data/Regression command in Lotus.

References: O'Leary, T.J. "Data/Matrix and Data/Regression Commands." *The Student Edition of Lotus 1-2-3*. Addison Wesley, 1988.

Ewing, D.P and D.F. Noble. "Data Management." *Using 1-2-3 Special Edition*. Que Corp, Carmel, Ind., pp. 530 and 856-57, 1987.

PROCEDURE

(1) You are to develop the worksheet shown in Figure 16.1. ***First retrieve the worksheet REGRESS.*** The worksheet should contain five columns of 20 numbers. The first column is time period or observation number. Column B contains the copy or dependent variable we will use in this regression. The numbers represent per capita milk consumption. Column C to E are our explanatory or X variables. They represent, respectively, retail price of milk, median family income, and population density.

(2) Form the Y vector and X matrix.
First, ***/Copy B2.B21 to A24.A43.*** This will be our y vector.
Then, ***/Copy C2.E21 to C24.E43.***
Use the ***/Data Fill*** command generate a column of ***1's in cells B24.B43.***

Thus cells B24.E43 become our X matrix. Provide the headings in the range A23.E24. (Also provide the other headings as you are going along).

Figure 16.1. Completed Worksheet for Matrix and Regression Analysis With Lotus

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	...	AC
2	1	270	21.52	11.10	77		Constant			240.8926						
3	2	269	22.63	12.40	29		Std Err of Y Est			18.24995						
4	3	228	25.93	10.54	130		R Squared			0.691499						
5	4	233	26.33	9.68	115		No. of Observations			20						
6	5	286	21.22	12.00	178		Degrees of Freedom			16						
7	6	296	25.16	11.22	65											
8	7	264	25.31	12.40	41		X Coefficient(s)	-4.03382		10.71618	-0.02069					
9	8	286	23.70	14.10	226		Std Err of Coef.	2.535538		2.969189	0.033897					
10	9	236	26.40	11.05	13											
11	10	240	22.08	9.44	182											
12	11	241	25.45	10.72	320											
13	12	286	20.95	12.79	68											
14	13	292	21.84	15.66	284											
15	14	228	26.76	9.13	234											
16	15	259	25.25	11.15	12											
17	16	219	26.86	9.96	77											
18	17	326	22.95	13.89	20											
19	18	271	25.78	10.31	26											
20	19	228	27.24	8.71	55											
21	20	300	23.24	13.11	499											
22																
23	y	X1	X2	X3	X4		y-hat	u-hat								
24	270	1	21.52	11.10	77		271.4410	-1.44102								
25	269	1	22.63	12.40	29		281.8878	-12.8878								
26	228	1	25.93	10.54	130		246.5540	-18.5540								
27	233	1	26.33	9.68	115		236.0349	-3.03499								
28	286	1	21.22	12.00	178		280.2056	5.794334								
29	296	1	25.16	11.22	65		258.2921	37.70782								
30	264	1	25.31	12.40	41		270.8288	-6.82885								
31	286	1	23.70	14.10	226		291.7124	-5.71247								
32	236	1	26.40	11.05	13		252.5445	-16.5445								
33	240	1	22.08	9.44	182		249.2203	-9.22036								
34	241	1	25.45	10.72	320		246.4873	-5.48736								
35	286	1	20.95	12.79	68		292.0368	-6.03689								
36	292	1	21.84	15.66	284		314.7323	-22.7323								
37	228	1	26.76	9.13	234		225.9439	2.056013								
38	259	1	25.25	11.15	12		258.2757	0.724228								
39	219	1	26.86	9.96	77		237.6839	-18.6839								
40	326	1	22.95	13.89	20		296.7503	29.2496 3								
41	271	1	25.78	31	26		246.8463	24.15346								
42	228	1	27.24	8.71	55		223.2111	4.788859								
43	300	1	23.24	13.11	499		277.3096	22.69039								

								-0.00000								

Note the X' matrix extends through column AC

X Transpose Matrix

1	1	1	1	1	1	...	1
21.52	22.63	25.93	26.33	21.22		...	23.24
11.10	12.40	10.54	9.68	12.00		...	13.11
77	29	130	115	178		...	499

X'X

20	486.6	229.36	2651
486.6	11923.08	5535.439	63508.85
229.36	5535.439	2693.022	31471.23
2651	63508.85	31471.23	660465

Inverse of X'X

22.53489	-0.62712	-0.62710	-0.00026
-0.62712	0.019302	0.013560	0.000014
-0.62710	0.013560	0.026469	-0.00004
-0.00026	0.000014	-0.00004	0.000003

X'y	Beta Est
5258	240.8926
127127.3	-4.03382
61129.82	10.71618
706007	-0.02069

(3) Transpose the X matrix using the /Range Data Transpose command. This command is similar to the /Copy command except the "from" range is transposed when copied to the "to" range. The "from" range here should be our X matrix, which is B24.E43. Specify J24, the starting point of the X transpose, as the "to" range. The specific commands are

/RT	for Range Transpose
B24.E43	Range to copy from
J24	Range to copy to.

(4) Now we need to multiply X transpose with X to come up with X'X. Matrix multiplication in Lotus can be done with the /Data Matrix Multiply command. This command requires you to specify three things: the first range (or matrix) to multiply which in our case is J24.AC27; the second range to multiply where you should just specify the location of the X matrix; and output range, which is the location where the result of the multiplication should be put, in our case this should be J30. The specific commands are

/DMM	for Data, Matrix, Multiply
J24.AC27	First Range to Multiply (the X' matrix)
B24.E43	Second Range to Multiply (the X matrix)
J30	Output Range (the X'X matrix).

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(5) The inverse of X'X can be computed using the /Data Inverse command. Specify the location of the X'X matrix as the range to be inverted, and J36 as the output range. The specific commands are

/DMI	for Data, Matrix, Invert
J30.N30	Range to Invert
J36	Output Range.

(6) Now multiply X transpose and the y vector using the /Data Matrix Multiply command and put the result in location as shown in the figure.

/DMM	for Data, Matrix, Multiply
J24.AC27	First Range (the X' matrix)
A24.A43	Second Range (the Y matrix)
J42	Location for X'Y.

(7) Similarly multiply $(X'X)^{-1}$ and X'Y to arrive at beta hat [$B = (X'X)^{-1}X^{1}Y$] and put the result in the location as shown in Figure 16.1.

/DMM	for Data, Matrix, Multiply
J36.M39	First Range (the X X inverse)
J42.J45	Second Range (the X'Y column)
L42	Output (beta hat).

(8) The y-hat column located at G24.G43 is most easily computed as XB. Again the /Data Matrix Multiply command can be used.

/DMM	for Data, Matrix, Multiply
B42.E43	First Range (the X matrix)
L42.L45	Second Range (the B matrix)
G24	Output Range (y-hat).

(9) The u-hat column is the difference between y and y-hat.

(10) ***Cell H45*** is the sum of the residuals. The ***@sum function*** should be used here.

(11) That is a lot of trouble to go through to get a regression! Luckily Lotus has a facility whereby regression can be done more directly and painlessly. All you need to do is to tell Lotus where your y variable is, where your X variable are (no need for using a column of 1's) and where you want to store your result. Lotus will then do the rest for you. The name of the command is /Data Regression. After you invoked this command, specify B1.B20 as your dependent variable, C1.E20 as your explanatory variable, and G1 as your output range. Lotus will then put the regression results starting at G1. The specific commands are

/DR	for Data Regression
C24.D43	X-Range (the X' matrix)
A24.A43	Y-Range (the Y matrix)
G2	Output Range
GO	to do the regression.

Compare the regression coefficients by both methods. You can calculate the "T" values of the regression by dividing the "X" coefficient in row 8 by the standard error in row 9.

(12) Plot a graph showing the predicted and actual y as demonstrated in Figure 16.2.

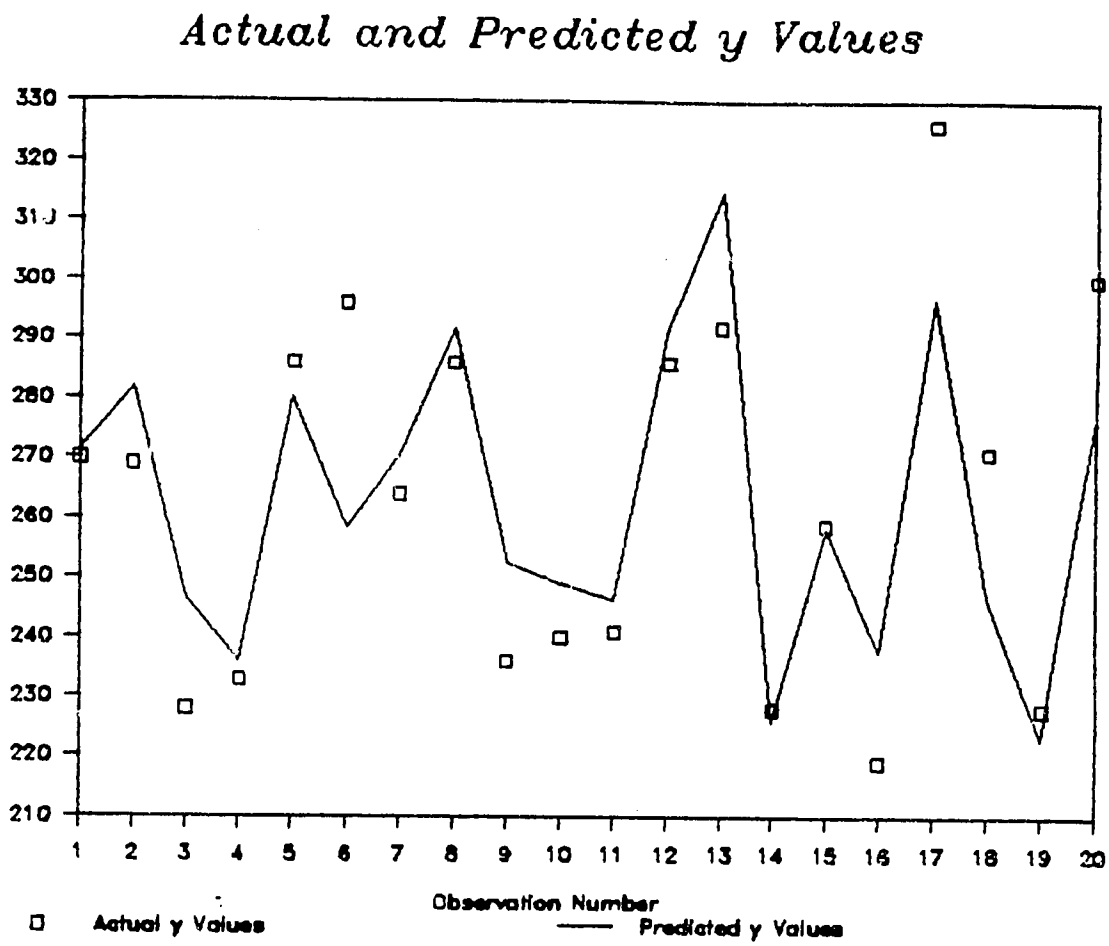

Figure 16.2. Actual vs. Predicted per Capita Consumption of Milk

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Lesson 17

MULTIPLE REGRESSION

USING TSP

Prepared by Elton Li, Art Stoecker, and Daryll Ray

OBJECTIVES

There are two exercises in this lesson. A microcomputer statistical package, TSP, is used for performing multiple regression computations.

The objectives are to provide experience in

a. Entering and editing data,
b. Transforming data,
c. Setting up a regression model,
d. Running the regression,
e. Interpreting and using the results.

References: Ray, D.E., "Regression and Statistical Methods", Chapter 2 in *Agricultural Policy Analysis Tools for Economic Development* by Tweeten, et al., APAP Oklahoma State University, Forthcoming.

Hall, R.E. and D.M. Lilien, *Micro TSP User's Manual*, Chapters 1-4, Quantitative Micro Software, Irvine, California, 1986.

EXERCISE 1. ESTIMATING THE INDEX OF PRODUCTION FOR A SPECIFIC CROP

In this exercise you will be asked to enter the data shown below which will be then be used to determine if changes in soybean production can be explained by reference to prices for soybeans and feed grains. In general, we expect producers to increase soybean production (as measured by the index of soybean production) when the the price of soybeans increases relative to the price of feed grains and that producers would reduce soybean production (and plant feed grains) when the price of feed grains increases relative to the price of soybeans.

The procedure for running TSP is explained in detail in the TSP USER'S GUIDE, Pages 3-8 through 3-18. The major steps are shown below for your convenience. to invoke TSP, insert the disk with the TSP program in drive A and insert a formatted data disk in drive B, ***type TSP***

Year	Soybean Production Index (1960=100)	Soybean Price Index (1959=100)	Feed Grain Price Index (1959=100)	Price Deflator (1959=100)
1959	59.70	110.05	119.71	77.87
1960	58.58	126.30	139.94	78.94
1961	59.00	139.37	154.23	84.30
1962	61.51	138.97	148.51	86.14
1963	63.18	139.34	141.32	86.91
1964	73.22	125.85	134.15	88.21
1965	79.50	113.38	121.55	89.51
1966	89.54	111.08	122.97	92.57
1967	89.12	105.62	104.78	96.02
1968	102.09	102.41	105.83	98.47
1969	95.82	100.00	100.00	100.00
1970	100.00	108.46	95.51	101.68
1971	113.81	116.72	107.17	102.99
1972	116.74	119.41	107.61	104.13
1973	120.50	128.02	106.11	105.51
1974	129.71	133.55	111.96	107.12
1975	145.61	129.58	110.92	109.19
1976	154.39	140.58	117.12	112.17
1977	169.46	134.57	113.33	109.49

The above table contains SOYBEAN PRODUCTION INDEX (1960=100), SOYBEAN PRICE INDEX (1959=100), FEED GRAIN PRICE INDEX (1959=100) and PRICE DEFLATOR (1959=100).

(1) Enter the four series into TSP. The four series should be respectively named SPRO, SPRC, FPRC, and PD.

At the prompt (>) type:
>***Create*** or press the F2 key. Answer the following questions
Frequency? ***A*** for annual data
Starting date? ***1959*** first year in series
Ending date? ***1977*** last year in series

Enter the data. ***Press the F1 key*** until you see the data command for the F7 key, ***then press the F2 key*** or you can just type the word Data at the > prompt.

Series List? ***SPRO*** — for the soybean production index. Enter the data for the index of soybean production beginning with 59.70 (press return) and continue entering observations through the 1977 value. You will see the year 1977 again. ***Type END*** and the data screen will appear:

```
B backup | I# Insert | N# Go to# | X# delete# | E exit
1959        59.70
  .           .
  .           .
1977       169.46
1977       169.46   ← type end if data OK
OBS        SPRO
```

The commands at the top of the screen allow you to edit the data if you make a mistake. These instructions are explained in detail on pages 2-6 of the TSP User's Guide.

Enter the next series
>***Data***
Series List? ***SPRC*** ← Soybean Price Index
Enter the data for the soybean price index. ***Type END*** after the 1977 value has been entered.

>***Data***
Series List? ***FPRC*** ← Feed Grain Price Index
Enter the data for the feed grain price index. ***Type END*** after the 1977 value has been entered.

>***Data***
Series List? ***PD*** ← Price Deflator
Enter the data for the price deflator. Deflate the price index for soybeans and feed grains.

As you become more familar with TSP later on you may want to enter the names of all data series at once when the series list is requested. The data are entered as before except the years' observations for each data series is typed on the same line separated by a space. When return is typed, the data for that observation, say 1959, is matched up with data series names. The process is continued for each observation.

(2) Use the GENR command to compute the DEFLATED price indexes for Soybeans and Feedgrains. Call these series respectively SDPRC and FDPRC.

a. Deflate the soybean price by dividing the index of soybean prices by the price deflator
Type or use the F8 key
>***GENR SDPRC = SPRC/PD***

The computer should respond with "SDPRC computed" which means that an additional variable has now been calculated.

b. Deflate the Feed Grain Price
>***GENR FDPRC = FPRC/PD***

c. Save the data series.
>SAVE B:SOYBEAN

This command will save all variables in a single file SOYBEAN on drive B. See also page 13-4 for using the STORE command to save a single variable.

(3) Perform a regression with SPRO as the dependent variable, and lagged SDPRC and lagged FDPRC as independent variables. As a check, the output form the Least Squares Regression is shown below.

The least squares regression routine is called LS. To perform a regression you would enter (but not now)

>LS
Dependent variable? ***SPRO***
Independent variable list? ***C SDPRC(-1) FDPRC(-1)***

The C is for a constant or intercept. The (-1) attached to each independent variable means that the variable is to be lagged one period. A (-2) would mean that a variable is to be lagged two periods. See pages 3-10 through 3-13 of the TSP User's Guide for additional information. (The above commands will cause the computer to return a range error. The problem occurs because we must discard or not use the 1959 value of the dependent variable since the 1959 values of SDPRC and PDPRC are used with the 1960 value of SPRD.) We simply reset the data range with the SMPL command.

Type
>SMPL or use the F2 key
Sample Range? ***1960 1977*** ← begin data range with 1960
now enter the LS regression (LS) command
>LS SPRD C SDPRC(-1) FDPRC(-1)

```
LS // Dependent Variable is SPRO
Date: 9-14-1988 / Time: 1:04
SMPL range: 1960  -  1977
Number of observations: 18
==========================================================================
     VARIABLE     COEFFICIENT    STD. ERROR       T-STAT.    2-TAIL SIG.
==========================================================================
        C          124.63772     22.293722      5.5907095      0.000
    SDPRC(-1)      192.49531     38.827040      4.9577643      0.000
    FDPRC(-1)     -212.30649     26.609845     -7.9774941      0.000
==========================================================================
R-squared                0.879816    Mean of dependent var    101.2222
Adjusted R-squared       0.863791    S.D. of dependent var    33.61801
S.E. of regression       12.40723    Sum of squared resid     2309.089
Durbin-Watson stat       0.939155    F-statistic              54.90417
Log likelihood          -69.22902
==========================================================================
```


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(4) Do the signs of the estimated coefficients agree with economic theory? Explain.

(5) Why did we deflate the two price indexes with the price deflator but not the production index? Is this a contradiction? Explain.

(6) Why did we lag the two independent variables one year?

EXERCISE 2. ESTIMATION OF A FERTILIZER RESPONSE FUNCTION AND USING THE FUNCTION TO MAKE A FERTILIZER RECOMMENDATION

OBJECTIVES

The specific objectives of this exercise are to

a. Estimate how the yield or grain sorghum responds to application of nitrogen and phosphorus.

b. Use the estimated coefficients of the response function to recommend the quantity of nitrogen and phosphorus which would give maximum expected profits.

DATA SOURCE

A data set from a sorghum fertility trial is available on a diskette from the instructor. In the experiment, the researchers used three levels of phosphorus (0, 40, or 80 kg/hectare), and 6 levels of nitrogen (0, 40, 80, 120, 160, or 200 kg/hectare). The experiment was replicated 4 times. There are 72 observations in all (3 phos x 6 nitrogen x 4 reps). The data are listed in Table 17.1.

NATURE OF THE RESPONSE FUNCTION

Your supervisor believes the "true" response function can be expressed as

$$Ygs = b1 + b2*N + b3*P + b4*N^2 + b5*P^2 + b6*R2 + b7*R3 + b8*R4$$

where

Ygs is the yield of grain sorghum in kg per hectare.
N is the amount of nitrogen in kg applied to one acre.
P is the amount of phosphorus in kg applied to one acre.
R2 is 1 if the yield is from a plot in rep2, otherwise R2=0.
R3 is 1 if the yield is from a plot in rep3, otherwise R3=0.
R4 is 1 if the yield is from a plot in rep4, otherwise R4=0.

Your supervisor also believes that b2>0, b3>0, b4< 0, and b5 <0. The dummy variables (R2, R3 and R4) are used because the average fertility was thought to vary

Table 17.1. Listing of Data Contained in the File SOREG

N	P	R2	R3	R4	REP	YIELD
0	0	0	0	0	1	2421
40	0	0	0	0	1	3720
80	0	0	0	0	1	4800
120	0	0	0	0	1	4692
160	0	0	0	0	1	4868
200	0	0	0	0	1	4676
0	40	0	0	0	1	2915
40	40	0	0	0	1	4392
80	40	0	0	0	1	5085
120	40	0	0	0	1	4965
160	40	0	0	0	1	5409
200	40	0	0	0	1	4795
0	80	0	0	0	1	3078
40	80	0	0	0	1	4451
80	80	0	0	0	1	4462
120	80	0	0	0	1	4882
160	80	0	0	0	1	5129
200	80	0	0	0	1	5103
0	0	1	0	0	2	2609
40	0	1	0	0	2	3780
80	0	1	0	0	2	5580
120	0	1	0	0	2	5547
160	0	1	0	0	2	5976
200	0	1	0	0	2	6076
0	40	1	0	0	2	3269
40	40	1	0	0	2	4078
80	40	1	0	0	2	5746
120	40	1	0	0	2	5316
160	40	1	0	0	2	6151
200	40	1	0	0	2	6092
0	80	1	0	0	2	2939
40	80	1	0	0	2	3962
80	80	1	0	0	2	5878
120	80	1	0	0	2	6191
160	80	1	0	0	2	6752
200	80	1	0	0	2	6290
0	0	0	1	0	3	2026.2
40	0	0	1	0	3	2378.3
80	0	0	1	0	3	3104.8
120	0	0	1	0	3	3717.9
160	0	0	1	0	3	4702.8
200	0	0	1	0	3	4079.8
0	40	0	1	0	3	994.9
40	40	0	1	0	3	2141.6
80	40	0	1	0	3	3037.3
120	40	0	1	0	3	4118.7
160	40	0	1	0	3	3878.5
200	40	0	1	0	3	4650.9
0	80	0	1	0	3	1288.9
40	80	0	1	0	3	2397.3
80	80	0	1	0	3	2864.3
120	80	0	1	0	3	3957.4
160	80	0	1	0	3	4448.8
200	80	0	1	0	3	4220.6
0	0	0	0	1	4	1013
40	0	0	0	1	4	3653
80	0	0	0	1	4	5173
120	0	0	0	1	4	3988
160	0	0	0	1	4	5232
200	0	0	0	1	4	4918
0	40	0	0	1	4	1993
40	40	0	0	1	4	3832
80	40	0	0	1	4	4636
120	40	0	0	1	4	6440
160	40	0	0	1	4	5191
200	40	0	0	1	4	6325
0	80	0	0	1	4	1609
40	80	0	0	1	4	3273
80	80	0	0	1	4	4658
120	80	0	0	1	4	5715
160	80	0	0	1	4	5797
200	80	0	0	1	4	6262

significantly between the four replications. Since an overall intercept is used, the dummy variable is omitted for rep 1.

PROCEDURE

1. Start the TSP program. ***When you see the > prompt type***

LOAD SOREG from the data disk. The file contains the following variables. A listing of the data is shown in Table 1.

REP indicates if the data is from rep 1, rep 2, rep 3, or rep 4.
Yield is the yield of grain sorghum in pounds per acre.
N is the number of pounds of nitrogen applied to one acre.
P is the number of pounds of phosphorus applied to one acre.
R2 a zero or one dummy variable described above.
R3 a zero or one dummy variable.
R4 a zero or one dummy variable.

You should examine the relationships in the data set by using the show, plot and graph commands.

2. Humor your supervisor by trying the suggested model.

   a. ***Use GENR*** to create the necessary squared terms like NSQ and PSQ

   b. Fit the model using the LS command

LS Yield C N P NSQ PSQ R2 R3 R4

You should get the regression output shown below.

```
                        LS // Dependent Variable is YIELD
Date: 9-13-1988 / Time: 6:03
SMPL range:    1  -    72
Number of observations: 72
     VARIABLE    COEFFICIENT   STD. ERROR      T-STAT.   2-TAIL SIG.
        C         2152.1050     184.18252     11.684632     0.000
        N         36.715159     3.0515736     12.031550     0.000
        P         10.418699     6.4530100     1.6145487     0.112
       NSQ       -0.1075050     0.0146458    -7.3403450     0.000
       PSQ       -0.0854649     0.0774981    -1.1027987     0.274
        R2        688.27778     165.32937     4.1630702     0.000
        R3       -1213.0000     165.32937    -7.3368693     0.000
        R4       -7.5000000     165.32937    -0.0453640     0.964

R-squared                0.888965    Mean of dependent var    4302.667
Adjusted R-squared       0.876821    S.D. of dependent var    1413.195
S.E. of regression       495.9881    Sum of squared resid     15744269
Durbin-Watson stat       1.991060    F-statistic              73.19929
Log likelihood          -544.7951
-----------------------------------------------------------------------
```


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c. Examine the statistics in terms of correctness of sign and as to whether the coefficients are significantly different from zero. You may wish to try alternative models.

3. Use the coefficients of the model you have estimated to make recommendations on the amount of fertilizer to apply to maximize gross profits. Recall that gross profit is the difference between total receipts and fertilizer expense. This can be expressed as

$$\text{profit} = Pgs*Ygs - Cn*N - Cp*P.$$

If the quadratic model suggested by your supervisor is used, the relationship is

$$\text{profit} = Pgs(\, b1 + b2*N + b3*P + b4*N^2 + b5*P^2$$

$$+b6*R2 + b7*R3 + b8*R4) - Cn*N - Cp*P$$

Find the amount of N to apply to maximize profit by setting the first derivative of the profit function with respect to N equal to zero and solve for N.

$$\frac{\partial \text{Profit}}{\partial N} = Pgs(\, b2 + 2b4*N) - Cn = 0,$$

so that $N = \dfrac{Cn/Pgs - b2}{2\ b4}$

Find the amount of P to apply to maximize profit by setting the first derivative of the profit function equal to zero and solve for P

$$\frac{\partial \text{Profit}}{\partial P} = Pgs(\, b3 + 2b5*P) - Cp = 0,$$

so that

$$P = \frac{Cp/Pgs - b3}{2\ b5}$$

Note that since the supervisor did not include an NP interaction term, you can solve for N and P without using simultaneous equation techniques.

Assume that grain sorghum is worth \$.05 per kg, the cost of N is \$.30 per kg and the cost of P is \$.40 per kg. Substitute the regression coefficients and the prices in the above equations and solve for N and P.

After substituting the prices and the coefficients in the equation to determine the optimal level of nitrogen we have

$$N = \frac{.05/.3 - 36.715}{2 * (-.10750)} = 169.99 \text{ kg/hectare.}$$

For phosphorus we have

$$P = \frac{.05/.40 - 10.419}{2 * (-.08546)} = 53.64 \text{ kg/hectare.}$$

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Based on the expected prices and the model used, the recommended levels of N and P would be 170 and 54 kgs per hectare, respectively. How might you adjust the results if it was believed that producers obtained only 70 percent of the response obtained by researchers?

Lesson 20

USING THE DATA BASE COMMANDS IN LOTUS

Prepared by Art Stoecker and Elton Li

OBJECTIVES

The objectives of this lesson are to familiarize the user with the Database Commands in Lotus type spreadsheets. These commands include sorting, querying with the intent to find or extract, and for simple statistics (mean and standard deviation) of data series.

References: O'Leary, T.J. "Creating a Database," Chapter 7 and "Using a Database" in *The Student Edition of Lotus 1-2-3*. Addison Wesley, 1988.

Ewing, D.P and D.F. Noble. "Data Management." Chapter 13 in *Using 1-2-3 Special Edition*. Que Corp, 1987.

The data commands are available from the main command line.

```
Worksheet  Range  Copy  Move  File  Print  Graph  Data  System  Quit
Fill,  Table,  Sort,  Query,  Distribution,  Matrix,  Regression,  Parse  .
```

A brief summary of the Data commands and their uses is described in this handout. In addition you will find Chapter 13 "Data Management" pp 457-532 in *Using 1-2-3*, Special Edition, by Ewing, Noble, et al to be helpful.

The data base commands can best be illustrated by practice. A data set from the Maputo market is available on a diskette from the instructor.

Enter the Lotus worksheet , put the data disk in drive B and type

/ F R MAPUTO

After loading the MAPUTO file, you should see the following information.

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3				Maputo Central Market							
4											
5	Yr	Mo	Da	Commodity	MinPrice	MaxPrice	Qsold	R	P	S	#Sell
6	86	4	27	Avocado	200	250	66	1	2		13
7	86	5	27	Avocado	200	250		1	2		15
8	86	5	13	Avocado	200	250		1	2		15
9	86	6	3	Avocado	350	400		1			3
10	86	6	12	Avocado	250	300		1			5
		:									
175	87	4	28	Cassava	150	250					10
176	87	5	5	Cassava	200	300					6
177	87	5	12	Cassava	250	300					8
178	87	5	19	Cassava	250	300					12
179	87	5	26	Cassava	125	300	1400		1		14
180	87	6	2	Cassava	250	300	850		1		10

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The data shown is in alphabetical order by commodity. Assume we wish to sort this data in order by the date on which it was collected. This can be done with the / Data Sort commands in Lotus.

Type ***/ D S*** or type / then ***highlight Data*** then ***Sort*** to get the following menu.

Data-Range Primary-Key Secondary-Key Reset Go Quit Specify records to be sorted

The commands have the following functions.

Data-Range	This is the range of the data to be sorted. In our example this will be A6.K180. Note that column headings are not included in the data range when sorting.
Primary-Key	The primary key (really a column of data) is the item which has primary importance or comes first.
Secondary-Key	The column of data which is the secondary sort. The secondary key is optional but the primary key must be specified. If we wanted to sort by month and by days within each month, we wound designate the column with the month as the primary key and the column with the day of the month as the secondary field.
Reset	This cancels the sort range and the sorting keys.
Go	This performs the actual data sort
Quit	Return the worksheet and Ready mode.

Data Sorting Example

Assume we want a listing of the data in order by the date on which the observation was collected. The order would be year, month within year, and day within month. This presents a small challenge since three columns are involved and there are only two sorting keys. This will be solved by sorting the data in three steps.

1. Sort the data in order by year
2. Sort the data for 1986 by month and by day
3. Sort the data for 1987 by month and by day

Step 1 Type ***/ D S*** or / and highlight Data then Sort.

Data-Range ***A6.K180***

Primary key ***A6*** Sort Order (A or D) ***A*** (ascending) (do not declare a secondary key)

Go to preform the sort (after the sort, the 1986 observations should be in rows 6 through 114 and the 1987 data should be in rows 115 through 180)

Step 2 To sort the 1986 data by month and day

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Type ***/ D S*** or type / then highlight Data then Sort

Data-Range	***A6.K114***	(only the 1986 data)
Primary-Key	***B6***	(the column with the month)
Secondary-Key	***C6***	(the column with the day of the month)
Go		(to perform the sort)

(after the sort is finished, the 1986 data should be in order by month and day within each month)

Step 3. Sort the 1987 data by month and day

Type ***/D S*** or type / the highlight Data then Sort

Data-Range	***A115.K180***	(only the 1987 data)
Primary-Key	***B115***	(Column with month code)
Secondary-Key	***C115***	(column with day code)
Go		(to perform the sort)

(after the sort the 1987 data should be in order by month and day within each month)

SEARCHING FOR SPECIFIC RECORDS WITH FIND, UNIQUE AND EXTRACT

The ***/ Data Query*** command provides the ability to search the data base for records which meet certain criterion. When the desired record(s) have been found, these records can be

a. edited

b. extracted

c. deleted

The Query command requires the user to specify

a. ***An input range.*** This is the portion of the worksheet worksheet **including column labels** where the data to be searched is located.

b. ***A criterion range.*** This is the Area of the worksheet which tells the computer in which column to search and what to look for when it does search that column. A criterion range contains at least two rows. The first row contains a heading like that in the worksheet and the second row contains a formula or label used to select entries from the indicated column.

c. ***An output range.*** This range must be specified if the Extract or unique options are selected. This tells the computer where to store the copies of the records which meet the criterion.

Preparation for Using the Query Command.

Before the Query command is used it is useful to set up the labels and formulas which will be used for the Criterion range and for the output range. First we must have an objective in mind. Assume that out task is to simply to make a list all cassava sales in the data set. The following steps will accomplish this objective.

Step 1 Enter the labels and information for the criterion range. The criterion range can be placed anywhere in the worksheet where there is unused space. In this example we will use cells L1 and L2.

Move the cursor to L1, type Commodity. The spelling must be the same that in cell D5. This tells the computer the search under the column labeled commodity.

Move the cursor the L2, type Cassava. This is the crop we will search for in the commodity column. We are telling the computer to select all records in which the word Cassava is found in the column labeled commodity

Step 2 ***Setup the Output range.*** The computer has to have some place to copy the selected information. This information can be placed anywhere in the worksheet which is not being used. In this case we want to collect to information on the date of sale, the commodity, the minimum price and the maximum price. We will place this information in columns M through R. To establish the output range we just need to have the appropriate column headings in the first row of the range. The column headings should be spelled the same as in the column headings in the first row of the input range. Hint, the safest way is to copy the column headings.

Move the cursor to A5. (Use the copy command) / ***Copy***

Range to copy from	***A5.F5***	(This will copy the
Range to copy to	***M5***	labels to the output range)

Step 3. Use the / Data Query command to tell the computer the size of the input range, the location of the criterion range and the location of the output range.

Type / D Q to or type / ***then highlight Data then Query*** to get the following menu Query submenu

```
Input  Criterion  Output  Find  Extract  Unique  Delete  Reset  Quit
Set the range containing data records
```

Select Input	(Note we have included the labels
Enter Input range: A5..K180	in row 5 as part of the input range)

Select Criterion
Enter Criterion range: L1.L2

(This is the area where we entered

	L
1	Commodity
2	cassava

Select Output
Enter Output range: M5.R5

(This will be the first row of the output range. This is the row which contains the column labels for the output)

Select Extract

(This will cause the computer to search the data base and copy all records which contain the word cassava into the output range below row 5 in columns M through R.)

Select Quit and then ***move the the cursor to Column M*** to check the extracted output.

Change the Criterion.

Move the cursor to L2 and type ***banana***
Type / D Q E (/ Data Query Extract) This will cause Lotus to replace all of the previously selected items with those which contain the word banana

More Complex Extraction Formulas

Assume that we want to find all sales which were bananas AND where the minimum selling price was over 250. This is done by adding an additional column to the criterion section.

Use the ***/ Copy*** command to copy the label in ***cell E5 to M1***
Move the cursor to M2, type +E6>250. The expanded criterion table should now appear as

	L	M	
1	commodity	MinPrice	
2	banana	+E5>250	← the formula will not show unless you use the / Range Format Text option.

The addition of the second column in the criterion range is adding an AND condition. We are asking the computer to search for records which have both the word banana in the commodity column and also which have a minimum sales value greater than 250.

Type / D Q
Input Criterion L1.M2 ← set the range to include the new column

Select Extract
Select Quit ← to view the worksheet and see what has been extracted

Adding Rows to the Criterion Range

When an additional column was added to the criterion range, the effect was a logical AND. That is our selection had to meet both conditions. Additional rows can be added to the criterion range but the effect is different. The effect is OR or either. For example in addition to bananas where the minimum price is over 250 we also want the list to include all cassava sales where the minimum price was greater than 300.

Move the ***cursor to L3, type Cassava***
Move the ***cursor to M3, type +E6>300***

Type ***/ D Q***		← / Data Query
Input-Criterion	***L1.M3***	← to enlarge the range
Select ***Extract***		← to extract the data
Select ***Quit***		

The result should be a list containing records of bananas where the mininum price was greater than 250 and a list of cassava sales where the minimum price was greater than 300.

DATABASE STATISTICAL FUNCTIONS

There are several statistical functions in Lotus which are designed to work with a data base. These functions are useful for obtaining statistical summaries of information in a data base. These functions include

@DCOUNT	Counts the number of items in a list
@DSUM	Obtains the sum of items in a list
@DMAX	Returns the maximum value of items in a list
@DMIN	Returns the minimum value of items in a list
@DVAR	Calculates the variance of items in a list
@DSTD	Calculates the standard deviation of items in a list
@DAVE	Calculates the average of all items in a list

The general form of the data base functions is

```
@Dfunction( input range, number cols to right, criterion range)
```

The last exercise will be to obtain a statistical summary of items in our data base. First let us expand on the idea of the criterion range which was developed previously. Recall the the criterion range has at least two rows. The top row is made up of selected column names. The second row may contain formulas or labels which are used in the selection process. If the cell in the second row of the criterion range in blank, then that column is ignored in the selection process. For example suppose we copy the entire column heading in row 5, columns A - K to Cell T1. Suppose we enter the number 6 under the month column and the word banana under the commodity column. If we

```
T  U  V     W          X         Y          Z   AA AB AC    AD
Yr Mo Da Commodity MinPrice MaxPrice    Qsold R  P  S    #Sell
   6       banana
```

designate T1.AD2 as the criterion range, the effect is to select only sales of bananas in month 6. The advantage of this form is that the selection criterion can be quickly changed.

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You want a summary of Cassava sales in 1986, month 5, when there were at least 5 sellers. Just modify the criterion range as

T	U	V	W	X	Y	Z	AA	AB	AC	AD
Yr	Mo	Da	Commodity	MinPrice	MaxPrice	Qsold	R	P	S	#Sell
86	5		cassava							+E6>=5

Assume we want a general summary of the market information in the data base. ***We will copy the formulas in A5.K5 to T1.*** Enter the work Cassava in cell W2. Leave the remaining cells in the criterion row two blank for the moment. ***Enter the following labels in the indicated cells.***

	T	U	V	W
5		MinPrice	MaxPrice	
6	num obs			
7	Average			
8	Maximum			
9	Minimum			
10	Variance			
11	Std Dev.			

The following formulas should be entered into the indicated cells

		Col U	Col V
5		MinPric	MaxPric
6	No. Obs.	@DCOUNT($A$5..$K$180,4,$T$1..$AD$2)	@DCOUNT($A$5..$K$180,5,$T$1..$AD$2)
7	Average	@DAVG($A$5..$K$180,4,$T$1..$AD$2)	@DAVG($A$5..$K$180,5,$T$1..$AD$2)
8	Max obs	@DMAX($A$5..$K$180,4,$T$1..$AD$2)	@DMAX($A$5..$K$180,5,$T$1..$AD$2)
9	MinObs	@DMIN($A$5..$K$180,4,$T$1..$AD$2)	@DMIN($A$5..$K$180,5,$T$1..$AD$2)
10	Variance	@DVAR($A$5..$K$180,4,$T$1..$AD$2)	@DVAR($A$5..$K$180,5,$T$1..$AD$2)
11	St.Dev.	@DSTD($A$5..$K$180,4,$T$1..$AD$2)	@DSTD($A$5..$K$180,5,$T$1..$AD$2)

After typing in the above formulas, and entering the word cassava in cell W2, the worksheet should appear as

	T	U	V	W	X	Y	Z
	Yr	Mo	Da	Commodity	MinPrice	MaxPrice	Qsold
2				cassava			
3							
4							
5		MinPric	MaxPric				
6	No. Obs.	56	56				
7	Average	158.9285	222.3214				
8	Max obs	300	350				
9	MinObs	100	200				
10	Variance	1951.530	1599.968				
11	St.Dev.	44.17613	39.99960				

If you change the information in the criterion range, the summary will change. For example replace the word cassava with banana. Then enter a 1 under the month column.

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Lesson 21

INTRODUCTION TO REFLEX

THE DATABASE MANAGER

Prepared by Art Stoecker and Elton Li

OBJECTIVES

To provide a brief overview of the description of Reflex as described in chapters 1-3 of the Users Guide.

References: REFLEX: *The Analyst*, Chapters 1-3. Borland/Analytica Inc., Scotts Valley Drive, Scotts Valley Ca. 1987.

Cobb, Stephen. *Using reflex: The Database Manager*, Chapters 1 and 2. Borland-Osborne/McGraw-Hill, 1987.

BACKGROUND

DATABASE: Any collection of information arranged in a convenient order.

DATABASE PROGRAM: A program to help the user handle large quantities of information. The data base program usually contains features which:

a. Allows the user to designate records which contain one or more subfields. The format of the record and fields in each record are designed by the user.

b. Allow sorting of data records by one or more of the fields within each record.

c. Allow selection of those records which meet certain criterion. This process is called filtering in REFLEX.

d. Allow the printing of the entire file or those records which are selected by the user.

e. Allow the development of reports which summarize part or all of the information in the data base. For example an earnings report for a company or a summary of students grade averages by major study area.

In addition Reflex contains some features which are not commonly found in many database programs such as:

a. Cross Tabulation.

b. Graphics.

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REFLEX Has Five Major Views or Program Parts

Form View: Used to design the format of the data base. Form view will display a single record in data entry format.

List View: Show a list or table of records in row and column format similar to what you would expect in a spreadsheet.

Graph View: Displays up to 9 variables as scatter, line graphs, bar charts, or pie graphs.

Crosstab View: A summary of the data prepared with one variable displayed as rows and another variable displayed as columns.

Report View: Used to create custom business forms.

The users guide, (Reflex: The Database Manager uses an example from a sports equipment sales firm. We will also use our own Maputo SURVEY data set.

MAJOR KEYS (See the users guide, pp. 20-21 for more details)

The major keys in reflex are:

Key	Meaning
/	Displays Reflex Menus
Esc	Puts Menus away and leaves Edit mode
<-'	Enters data
F1	Display help messages
F2	Enters the Edit mode
F3	Selects a row in list and report views
F4	Selects a column in list and report views
Shift F5	Apply and remove search conditions
F6	Next View
F7	Move to previous record
Shift F7	Move to first record
F8	Move to Next record
Shift F8	Move to last record
F9	Recalculates any formulas
F10	Displays a list of choices
Cntrl Enter	Selects PROCEED

STARTING REFLEX. (after the system has been installed)

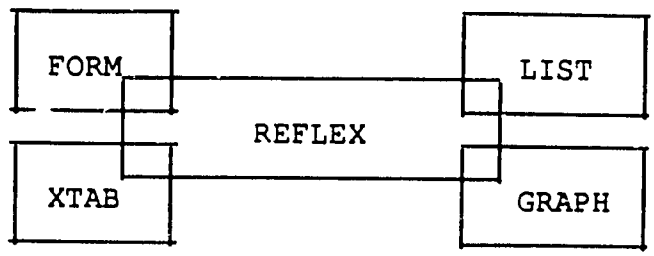
a. Put the disk containing your copy of the ***system disk in drive A:***

b. Put a ***formatted data disk in drive B:***

c. At the A:> ***type REFLEX***

d. You should see the following opening menu.

```
Views        Edit        Print/File        Records    Search
```



To Choose a menu, press the (/) key. For Help, press the F1 key

---

The main options Views, Edit, Print/File Records are listed across the top of the screen.

e. Type / V The following sub menu should appear. In the submenu, some of the options will appear in bold print and other options will appear in a fuzzy outline. The options in bold letters can be selected. The options which appear in fuzzy letters cannot be selected at this stage. For example the graph option appears in fuzzy letters. The graph option is unavailable because we have just started and do not have anything to graph at this time.

```
Views        Edit        Print/File        Records    Search
```

Form
List
Graph
Xtab
Close
Resize
Expand
Shrink
Next View
Quit

f. Press the ESC key to exit the form menu. (Reflex and Lotus have many keys in common. The / key activates the command line and the ESC key is used to exit or backout of a command.

CHECKING OUT THE REFLEX VIEWS. The Reflex report and utilities disk contains a data set from a sports equipment sales equipment firm. We will load this data set and use it to demonstrate the Form View and List View.

LOADING OR RETRIEVING A DATA FILE. The command to load a previously defined data file is under the Print/File command on the main command line. To load a file

type / P R (command Print/File Retrieve)

or

type / ← the command line
select Print/File ← use the right arrow key
select Retrieve ← use the down arrow key
press the Enter key

You should see the following input screen.

```
Views          Edit          Print/File          Records          Search

        RETRIEVE REFLEX DATABASE
        Directory B:\_____          ← Change directory to B:
              Name        _________

        Proceed     Cancel
```

Check the Directory or default disk drive. If the default drive is designated as A: and your data is on B:, first you need to use the UP arrow to move to the directory block and Enter B: If the drive indication is correct, then you can type the name of the file. It may be more convenient to ***use the F10*** or Choices key to obtain a listing of the files on the disk as shown below.

```
Views          Edit          Print/File          Records          Search

        RETRIEVE REFLEX DATABASE
        Directory B:\_____
              Name        _________
                 REFLEX FILE
                  SALESREP
                  PEOPLE
                  SURVEY          ← Select file, press ENTER
```

Use the UP and DOWN arrow keys to highlight the desired file (***SURVEY*** in this example) and ***press the Enter key.***

Next the computer will highlight the ***Proceed*** box. ***Press Enter*** if the choice is correct, otherwise use the right arrow to select Cancel and press enter. Assuming you have selected the SURVEY or Maputo data set, you should be returned to the FORM view which shows the information in one of the records in the dataset.

A SAMPLE FORM VIEW WITH DATA RECORD FROM MAPUTO SURVEY

```
Views          Edit          Print/File  Records          Search
 FORM

 Yr: 86
 Mo: 4
 Da: 27
 Commodity: Avocado
 MinPrice: 200
 MaxPrice: 250
 Qsold: 66
 R: 1
 P: 2
 J:
 #Sell: 13
```

To view additional records, use the

F8 key to move forward one record
F7 key to move back one record.

As you continue to press either the F7 or the F8 keys, the information to the left of the headings will change. The information with each item on the screen is referred to as a field within a record. The first field in the record is the year of observation. The second data field is the month and the third field is the date the survey was taken.

CHANGING FROM FORM VIEW TO LIST VIEW In the Form view, only one data record is shown at one time. In the List view, the data is presented as in a spreadsheet. The individual records are shown as rows and the fields within each records are represented as columns. To change for the form View to the List view,

type / V L R for Command View Replace

or type

/ to get the command line

use the down arrow to select List, press Enter

You should see the following menu at the bottom of the screen

Replace	Vertical	Horizontal

Select ***Replace***. The data screen should appear as shown below.

A SAMPLE FORM VIEW WITH DATA RECORD FROM MAPUTO SURVEY

Views Edit Print/File Records Search

LIST

Yr	Mo	Da	Commodity	MinPrice	MaxPrice	Qsold
86	4	27	Avocado	200	250	66
86	5	27	Avocado	200	250	
86	5	13	Avocado	200	250	
86	6	3	Avocado	350	400	
86	6	12	Avocado	250	300	
86	6	17	Avocado	200	250	
86	7	15	Avocado	250	300	
86	4	15	Banana	300	400	
86	4	22	Banana	300	400	
86	4	27	Banana	350	400	
86	5	6	Banana	250	400	
86	5	13	Banana	250	300	

Use the Arrow keys to scroll through the data set as you would with a spreadsheet. You can enter data and/or replace any entry by moving the cursor to a particular cell and typing the correct value. The following keys are also useful.

Home Moves to the first record in the data set
End Moves to the last record in the data set
PgUp Moves up one full screen
PgDn Moves down one full screen

Changing from the List to the Form View. Just type

/ V F R (command Form Replace) or use the arrow keys to change back to the Form View.

Displaying both the Form and the List Views on the same screen. It is possible to split the screen and show data in the Form and in the List View at the same time on the screen. Assuming the Form view is now displayed, type

/ V L V (command View List Vertical)

The choice between Horizontal and Vertical is where you indicate if you want the views side by side or one view on top of another.

Quitting Reflex. To quit reflex type

/ V Q (The quit command is in the View submenu)

Type Y in response to the question Yes or No.

The above is a quick introduction to some of the material in Chapter 3. However it should provide some background so you can begin with the Tutorial on page 251 of the users guide.

Lesson 22

USING REFLEX TO DERIVE PRODUCTION COEFFICIENTS BY SIZE OF OPERATION

Prepared by Art Stoecker and Elton Li

BACKGROUND

There are many cases in modeling when it is desirable to have production coefficients which are characteristic of certain farm types. For example production coefficients for traditional, mechanized, crop farms, large farms, small farms etc.

OBJECTIVES

The objectives are to illustrate the use of data base techniques such as sorting, filtering, and crosstabulation to select records and summarize characteristic which are representative of certain types of farms, present the results in cross tab form and in graphical forms.

References: Borland. "The Form View," Chapter 4; "The List View," Chapter 5; "The Graph View," Chapter 6; "The Crosstab View," Chapter 7; in *Reflex: The Analyst*, Borland/Analytica, 1987.

Cobb, S. "Traditional Views: Form and List," Chapter 3; "A Select View: Filtering and Crosstabs," Chapter 4; "A Clear View: Graph," Chapter 5; in *Using Reflex: The Database Manager*, Mcgraw Hill, 1987.

DATA

When the analyst needs data by certain farm types, the best method might be a direct survey of the specific farms involved. However the time and monetary resources for survey analysis are not always available. In the following example input-output coefficients for swine production by medium-to large and small swine producers in the Dominican Republic were needed for an agricultural sector model. The resources for a survey were not available. The data source used was a "Census" of swine producers for 1983 and 1985. The survey for 1983 is listed in Table 22.1. The fields or categories listed were

province	
region	one of eight regions
Year	either 1983 or 1985
Farms	no of farms with swine
All pigs	All pigs on farms
Adult Males	number of adult males on farms reporting
Unbred female	number adult unbred and non nursing females
Pregnant female	number of bred females
Female with pigs	number females nursing pigs
Unweaned pigs	number of nursing pigs
Growing female	number of young growing females pigs
Growing males	number of young growing males pigs
Fattening pigs	number of pigs being fattened for market

Table 22.1. Listing of Data in File SWDATA from the Census of Swine in the Dominican Republic

Region	Province	Reg.N	Year	All Pig	Farms	Adult ma	Unbred f	Pregnant	Females	Nursing	Growing	Growing	Fattenin
Central	Dist.Natio	1	1983	61861	289	626	2157	5422	1539	15455	12593	8521	15548
Central	SanCristob	1	1983	11239	297	221	555	1028	345	2550	2381	2657	1502
Central	Pervia	1	1983	3473	306	139	260	457	109	744	673	530	561
Central	Monte Plat	1	1983	15619	493	357	834	1342	524	4429	2414	2087	3632
Suroeste	SanJuan	2	1983	6518	768	346	579	695	339	2074	1143	1004	338
Suroeste	Estrelleta	2	1983	1069	189	80	146	121	67	373	131	119	32
Suroeste	Azua	2	1983	4120	638	130	242	464	190	1077	942	872	203
Norcentral	La Vega	3	1983	39741	1624	552	1581	3597	1264	8962	6719	5728	11338
Norcentral	Salcedo	3	1983	9230	794	170	311	1022	360	2414	1569	1634	1750
Norcentral	Mons.Noul	3	1983	8554	719	171	361	675	290	1820	2180	1605	1452
Norte	Puerto Pla	4	1983	29117	2141	670	1320	2924	1298	9441	3836	4111	5317
Norte	Santiago	4	1983	23931	682	477	1002	2567	1014	6689	2542	2604	7036
Norte	Espaillat	4	1983	35283	1284	505	1178	3488	1267	8962	5965	5826	8092
Nordeste	Duarte	5	1983	16877	466	243	483	1131	491	4630	3075	2600	4224
Nordeste	Sanchez Ra	5	1983	8392	459	224	563	850	499	3277	653	561	1765
Nordeste	M.T.Sanche	5	1983	17217	762	296	931	1570	638	4388	2814	2612	3968
Nordeste	Samana	5	1983	1144	114	42	192	161	42	282	137	84	204
Este	La Altagra	6	1983	36462	603	783	1514	3442	1546	10008	6900	6666	5598
Este	S.Pedro Ma	6	1983	2266	104	84	162	275	89	585	401	347	323
Este	El Seybo	6	1983	9882	301	275	838	918	410	2462	1956	1929	1094
Este	La Romana	6	1983	2956	21	70	91	259	70	579	513	423	951
Este	Hato Mayor	6	1983	25093	247	601	1660	2253	1129	6407	5333	4816	2494
Noroeste	Monte Cris	7	1983	2806	215	76	150	315	124	890	565	443	243
Noroeste	Dajabon	7	1983	3943	299	158	232	304	149	1023	873	777	427
Noroeste	Valverde	7	1983	6440	469	126	315	643	185	1741	1445	1272	713
Noroeste	Santiago R	7	1983	2026	222	86	166	200	93	661	321	267	232
Sur	Barahona	8	1983	3753	1440	135	262	421	156	893	521	295	1070
Sur	Pedernales	8	1983	391	122	37	68	41	21	112	8	12	92
Sur	Independen	8	1983	984	187	110	135	145	59	226	3	6	300
Sur	Bahoruco	8	1983	2302	752	88	197	246	72	396	834	274	195
Central	Dist.Natio	1	1985	71377	358	843	2859	6320	2060	15727	17225	15581	10762
Central	SanCristob	1	1985	16777	238	304	1428	1520	596	4644	4097	2526	1662
Central	Pervia	1	1985	8451	297	171	816	731	219	1604	2051	2132	727
Central	Monte Plat	1	1985	20536	639	550	1308	1911	601	4505	5049	4064	2548
Suroeste	SanJuan	2	1985	1436	199	57	343	130	30	200	239	90	347
Suroeste	Estrelleta	2	1985	130	33	10	69	15	3	21	8	2	2
Suroeste	Azua	2	1985	684	125	34	67	88	14	99	218	102	62
Norcentral	La Vega	3	1985	64702	1688	844	2573	4662	1925	14381	15142	13489	11686
Norcentral	Salcedo	3	1985	26685	976	327	886	1723	832	6550	6708	5578	4081
Norcentral	Mons.Noul	3	1985	15323	464	258	933	1196	522	3736	3518	3113	2047
Norte	Puerto Pla	4	1985	33941	1659	549	1668	2745	1218	8692	8254	6884	3931
Norte	Santiago	4	1985	55655	2121	898	2877	4328	1708	13474	10694	8696	12988
Norte	Espaillat	4	1985	52196	1963	607	1830	4022	1778	14477	11671	9658	8153
Nordestu	Duarte	5	1985	21948	974	751	1353	1549	656	5039	5612	4442	2546
Nordeste	Sanchez Ra	5	1985	11850	825	247	683	901	341	2512	3050	2564	1552
Nordeste	M.T.Sanche	5	1985	32343	1316	488	1545	2421	1051	7923	6520	6166	6229
Nordeste	Samana	5	1985	2787	280	84	209	286	78	565	845	627	93
Este	La Altagra	6	1985	26433	1054	424	1746	1840	740	5325	6571	6202	3585
Este	S.Pedro Ma	6	1985	3995	82	71	313	320	315	913	810	847	406
Este	El Seybo	6	1985	24159	543	396	1280	1755	640	4489	4588	4075	6936
Este	La Romana	6	1985	4362	40	50	161	326	122	859	1089	892	863
Noroeste	Monte Cris	7	1985	1631	242	42	106	147	54	307	510	347	118
Noroeste	[illegible]bon	7	1985	1779	299	55	166	216	60	400	448	342	92
Noroeste	[illegible]verde	7	1985	2519	271	56	156	275	87	614	714	538	79
Noroeste	[illegible]ntiago R	7	1985	2502	319	74	241	189	94	673	594	434	203
Sur	Barahona	8	1985	448	136	47	235	86	10	3	38	23	6
Sur	Pedernales	8	1985	39	17	1	25	1	1		7	6	
Sur	Independen	8	1985	109	32	6	44	6	1		28	15	10
Sur	Bahoruco	8	1985	307	112	26	161	21	6	36	35	11	11

The province level data is a total over of all groups of producers in the province. For example there is no pure measure of swine production by small farmers. However if producers in a given province are somewhat homogeneous and the differences between producer types are reflected by differences in provincial averages, then the provincial level data may be used as a substitute for direct survey data.

The Analysis

In the following example, the provincial level data has been provided on disk which can be loaded into the computer. Once the data has been loaded, it will be necessary to calculate some averages

Pigs per farm = All pigs/ Farms

Pigs per litter = Unweaned pigs/ Female with pigs

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Prod sows per farm =
(Females with pigs + pregnant female)/farms

total pigs per sow =
(Nursing pigs+growing females + growing males+fattening pigs)/
(unbred female+ pregnant females + females with pigs)

Producing females per male =
(Pregnant females+ females with pigs)/adult males

Insert the Reflex disk in drive a:
Type
REFLEX — to load the Reflex program
/ P R — for Command, Print-File, Retrieve
SWDATA or ***F10*** — to select the example data set
select
SWDATA
Move the Cursor to
PROCEED
Press ENTER — to load the data into memory

ENTERING FORMULAS
with
Field and Sort Setting

In this example, we will use the **Records Field and Sort Settings** Command to enter the formulas to calculate the averages discussed above. To use the this tool

Type
/ R F — for Records, Field and Sort Settings

You should see the following Field and Sort Setting screen

Field	Type	Formula	Sort #	Format	Prec
Region	Text				
Province	Text				
Region No.	Numeric				
All Pigs	Numeric				
Farms	Numeric				

PROCEED

Field The Field in the above form is the name of the variable or characteristic in the record.

Type The Type refers to the type of data, either text for a label like the province name or numeric for a characteristic like the number of farms in a province.

Formula The Formula field is where we will enter formulas to calculate values for new variables from the existing data, however the formula field is now empty

Sort # The Sort no is used in indicating the order in which the data fields are to be sorted. The sort field is not used in this example.

Format The Format field is used to format data the same way data was formatted with the range format command in Lotus. The default for numeric data is general.

Prec The Prec field is used to indicate the precision or number of decimal places. The Precision is indicated if the fixed or currency formats are used.

Adding New Fields and Entering Formulas

Use the arrow Keys to move the cursor to the last row in the Field column. (This cell should be blank). A new field or variable is added to the data set just typing in the name.

Pigs per Farm. The first variable we will add is pigs per farm. This variable will be calculated by dividing the total pigs in each province by the number of farms.

Move the Cursor to the Field column. Type Pigs per Farm
Move the Cursor to the Type column. Type Numeric
Move the cursor to the Formula column

Type Total Pigs/Farms

or

Press F10 (the choices), ***Select Total Pigs***
Type /
Press F10, Select Farms

Move the cursor to the Format column Type Fixed

Note that a 2 appears in the precision field for two places after the decimal. This completes the steps for the calculation of the number of pigs per farm.

The remaining variables are added to the data set in the steps described below.

Total Pigs per Sow.

Move the cursor to the blank row in the Field Column
Type Tot.Pigs per Sow
Move the cursor to the Type Column Type Numeric
Move the cursor to the Formula Column.
Type
(Fattening+female+male+Unweaned)/(pregnant+With Young)

or let Reflex build the formula

Type (
Press F10, Select Fattening, type +
Press F10, Select female, type +
Press F10, Select male, type +
Press F10, Select Unweaned, Type)/(
Press F10, Select Pregnant, type +
Press F10, Select With Young, Type) Press Enter

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Move the cursor to the Format field, either

type ***Fixed***

or

press the F10 key, select fixed

or

type " (the " means use the entry in the line above)

Repeat the above steps to create the variables below by entering the necessary names and formulas. Format the data to have two places after the decimal.

Breeding Females per Male, use the formula
(Pregnant + With Young)/ Adult Males

Size Class. Use the @IF statement to classify the provinces into those with medium to large farms and into those with small farms.

Move the cursor to blank row in the Field Column
Type Size Class
Move to the type field, enter TEXT
Move to the Formula Field, type the formula
@IF(pigs per farm<20,"Small","Med-Large")

The Completed data set should appear as

Field	Type	Formula	Sort #	Format	Prec
Region	Text				
Province	Text				
Region No.	Numeric			General	
All Pigs	Numeric			General	
Farms	Numeric			General	
Adult male	Numeric			General	
Unbred fem	Numeric			General	
Pregnant f	Numeric			General	
Female w p	Numeric			General	
Nursing pi	Numeric			General	
Growing fe	Numeric			General	
Growing ma	Numeric			General	
Fattening	Numeric			General	
Year	Numeric			General	
Pigs per f	Numeric	All Pigs/Farms		Fixed	2
Tot.pig pe	Numeric	(Fattening pigs + Growin		Fixed	2
Prod sow p	Numeric	(Females with pigs+Preqn		Fixed	2
Size Class	Text	=@IF(Pigs per farm<20,"S			

Proceed

When finished, Move the cursor to the PROCEED cell and press Enter

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CROSSTABULATION

The Crosstab View is entered by typing

/ V X for View Crosstab

The opening Crosstab screen appears as

```
Views      Edit      Print/File  Records    Search     Crosstab
XTAB ------------------------------------------------------------
Summary [              ]                    Field [              ]
          |      ALL      |
     ALL  |               |
          |               |
```

The first step is to fill in the Summary and the Field boxes.

Summary. The Summary command indicates the type of summary. To examine the type of choices available, ***place the cursor in the summary box and press F10. Choose @AVG*** which will add all of the values in the field specified.

Field. The Field command lets you select one of the variables or field names in the data set. ***Move the cursor to the field box and press F10.*** Choose the field name (e.g., ***Pigs per farm***).

Move the cursor to first Row over the word ALL. We will use the crosstab command to make a column for each size of herd.

Type / C for / Crosstab
Select For Each You should see the sub menu

```
          Crosstab For Each

For Each [X] Column [ ]  Row

Field Name [                    ]

     [Proceed]              [Cancel]
```

Press F10 to list variables
Select Size Class

The values in the first row of the table will be calculated.

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Cross Tabulation With Average Production
Characteristics by Size of Herd

Summary: @AVG Field: pigs per farm

	Size Class		
	Small	Med-Lar	ALL
ALL	8.10	53.92	30.63
=@AVG(All Pigs)	4016.1	26803.8	15216.8
=@AVG(pigs per sow)	4.99	6.97	5.96
=@AVG(Prod sow per	3.96	6.94	5.42
=@SUM(Farms)	12724	21585	34309
=@COUNT(Farms)	30	29	59

↑ enter these formulas to obtain additional characteristics in the same crosstab

Obtaining additional variables in the same cross tabulation. The standard cross tab allows you display only one variable or field in the cross tab table. However you can display data from additional fields or variables in the same table by the use of formulas in the row or column headings. In the above example, in the second row, the formula

=@AVG(All Pigs)

causes reflex to tabulate the average of the total number of pigs in each province labeled "Small" and in each province labeled "Med-Large"

The formula in the third row

=@AVG(pigs per sow)

causes reflex to calculate average number of pigs per sow for "Small", "Med-Large", and for All provinces.

The formula in the fourth row,

=@AVG(Prod sow per boar)

causes Reflex to take an average of the number of producing sows per boar in provinces characterized by "Small", "Med-Large", and ALL provinces.

The formula in the fifth row,

=@SUM(Farms)

causes Reflex to total the number of farms in those provinces characterized by small, med-large, and All farm sizes.

The formula in the sixth row,

=@COUNT(FARMS)

gives a count of the provinces which fall in each category.

Printing the Crosstab

The results of the crosstab can be printed on paper or "printed" to a text file by ***typing***

/ P P for Print/file Print

You will see the following screen

```
Views Edit  Print/File  Records  Search  Options

                 Print Settings
Title Line 1
Title Line 2
Output     [X]   To Printer [ ]   To Disk File
Margins  Left  2     Right  74
         Top   2     Bottom  6
Page Length    66    Setup String [          ]
Paper Feed:    [X]   Continuous   Single Sheet
Print Page     [1]   To     [100]

          [Print]  [Put Away]  [Cancel]
```

Print Setting Screen

Enter the titles, and the necessary printer settings. Move the cursor to the PRINT box and press enter to print out the active screen.

The instructions or commands to set up a particular crosstab can also be saved in a separate file. You may want to have several cross-tabulations for a given data set and do not want to reconstruct each crosstab. To save the instructions for a crosstab, Type

/ C S for Crosstab Save.

You will be asked to supply a file name for the crosstab.

The results obtained from the crosstab analysis indicate the coefficients related to productivity per breeding animal were much lower in provinces where the average herd size was less than 20 animals per farm than they were in provinces where the average herd size is more than 20 animals per farm. The analysis also indicates that most of the production occurs those provinces where there are more than 20 animals per farm.

GRAPHICAL ANALYSIS OF THE DATA

REFLEX GRAPH VIEW. The Graph View is entered from the Form View or the List View. ***Type***

/ V G for View, Graph.

You will see the prompt at the bottom of the screen,

```
Which Way?   [Replace]   [Vertical]   [Horizontal]
```

Choose Replace. You should see the opening Graph View as outlined in Figure 22.1.

```
[Views   Edit   Print/File   Records   Search   Graph   Type]

GRAPH                                          Scaling   ←x,y scaling
                                               Options   ←Summary, titles
                                               For Each  ←each Y variable
                                                Print    ←Save in PIC file

                 [x axis field]    ← Name of x variable goes here
[          ]  ← First Y variable goes here
```

Figure 22.1. Opening Screen for Reflex Graph View

When you enter the Graph View, two additional commands, Graph and Type appear on the menu bar at the top of the screen. ***Type***

/ T to see the type of graphs available.

Our objective is to obtain a feel for the data we are working with. We have classified provinces as having farms which are "small" where the average numbers of animals per farm was less than 20 and medium to large when the average number of animals per farm exceeded 20. We will examine this data from a graphical perspective.

Graphing the Data. The following steps will allow the user to set up an initial graph but these steps do not use all of the options which are available.

Select the X axis variable. (Farm Size).
Move the cursor to the X axis box,
Press F10, Select Size Class

Select the first Y axis variable (All Pigs)
Move the cursor to the Y axis box (see Figure 22.1)
Press F10, Select All Pigs

The Summary Command. You should now see the number of pigs for each province shown record by record. You can use the arrow keys to scroll through the data points. However this is "too much" if you are trying to get a feel for the data. A graphical summary would be preferred. The summary command is under the Graph - Options menu (see Figure 22.1). ***Type***

/ G O for Graph, Options. You should see the following subdean in the center of the screen.

```
Graph Options
Summary
Title          On    Off
X Grid         On    Off
Y Grid         On    Off
X Label with

Proceed        Cancel
```

← Summary box, indicates type of summary desired

Move the cursor to the summary box (see above) and press F10. You will see another submenu of types of summaries or ways the Y variable or characteristic can be tabulated.

```
@Count   <----- number of observations with characteristic
@Min     <----- Minimum observed value of characteristic
@Max     <----- Maximum observed value of characteristic
@Sum     <----- Total of all observations
@Avg     <----- Average of all observations
```

Move the cursor to the @Sum and press Enter. The graph should now consist of two points connected by a straight line. These points represent the total of all pigs on medium-large and all pigs on small farms. The data would be more meaningful if displayed as a bar graph. ***Type***

/ T B for Type Bar.

The graph should appear as shown in Figure 22.2. This shows that production is heavily concentrated in provinces where there are at least 20 animals per farm.

For Each Option. The For Each option provides yet another tool for letting us "see" the data. Use the For Each option to see how production changed between 1983 and 1985 on small and on medium-large farms. ***Type***

/ G F for Graph, For Each.

You will see the list of choices.

```
Fields
Adult males
All pigs
Farms
:
Year
```

← Select Year

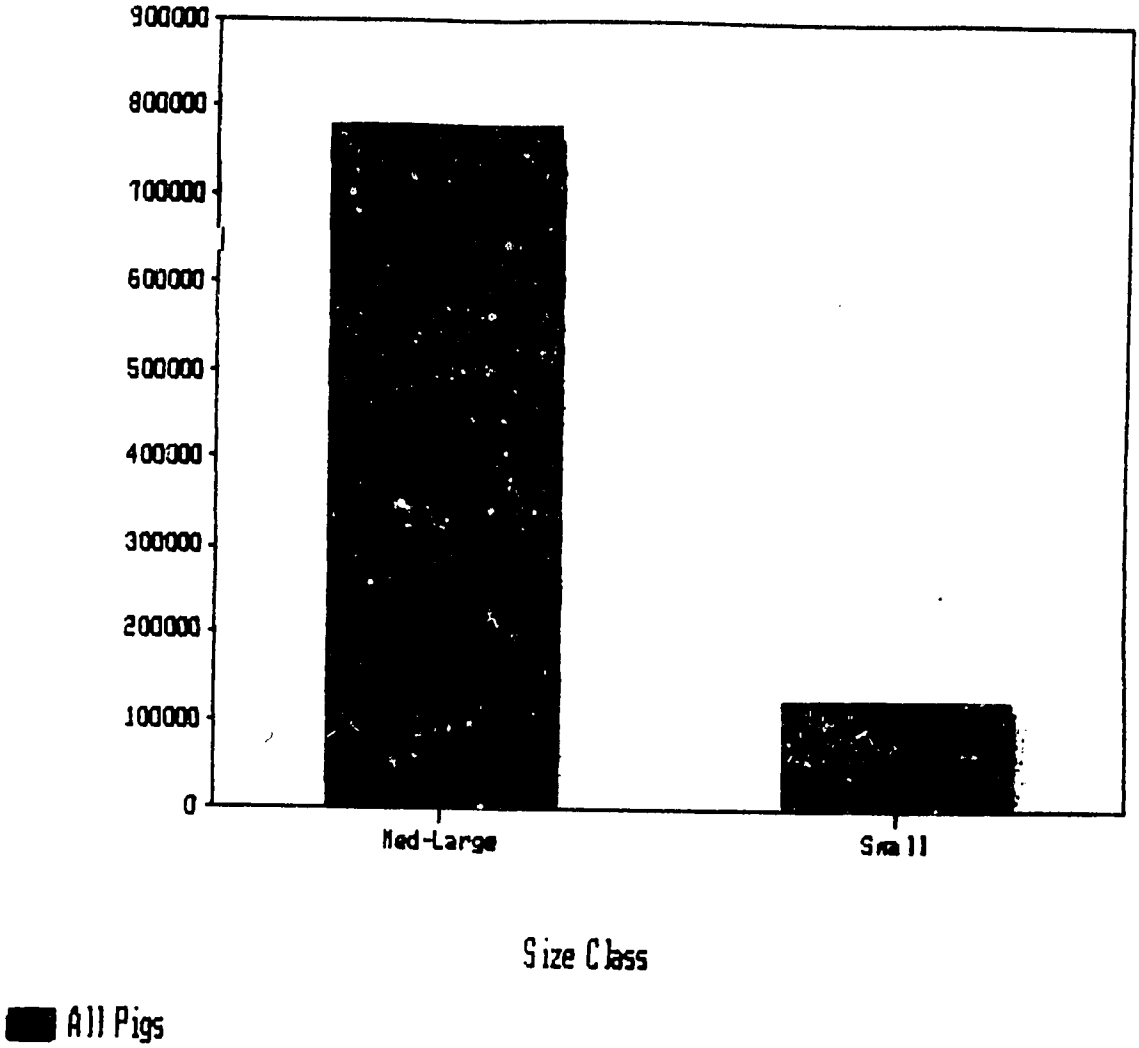

Figure 22.2. Graphical Summarization of Total Numbers of Pigs by Size of Farm

The For Each provides a graphical cross classification of the Y variable according to each level of the selected For Each variable. We will choose Year to obtain a graphical crosstabulation of pigs by farm size by year. Select Year. You should now see the graph shown in Figure 22.3. This graph indicates that animal numbers increased from 1983 to 1985 in provinces where there were more than 20 pigs per farm but that total production declined in provinces were there were less than 20 pigs per farm. The answer to one question often leads to another question, in this case why did one group of producer increase numbers while another group decreased. We will use Reflex and explore this question further in the next lesson.

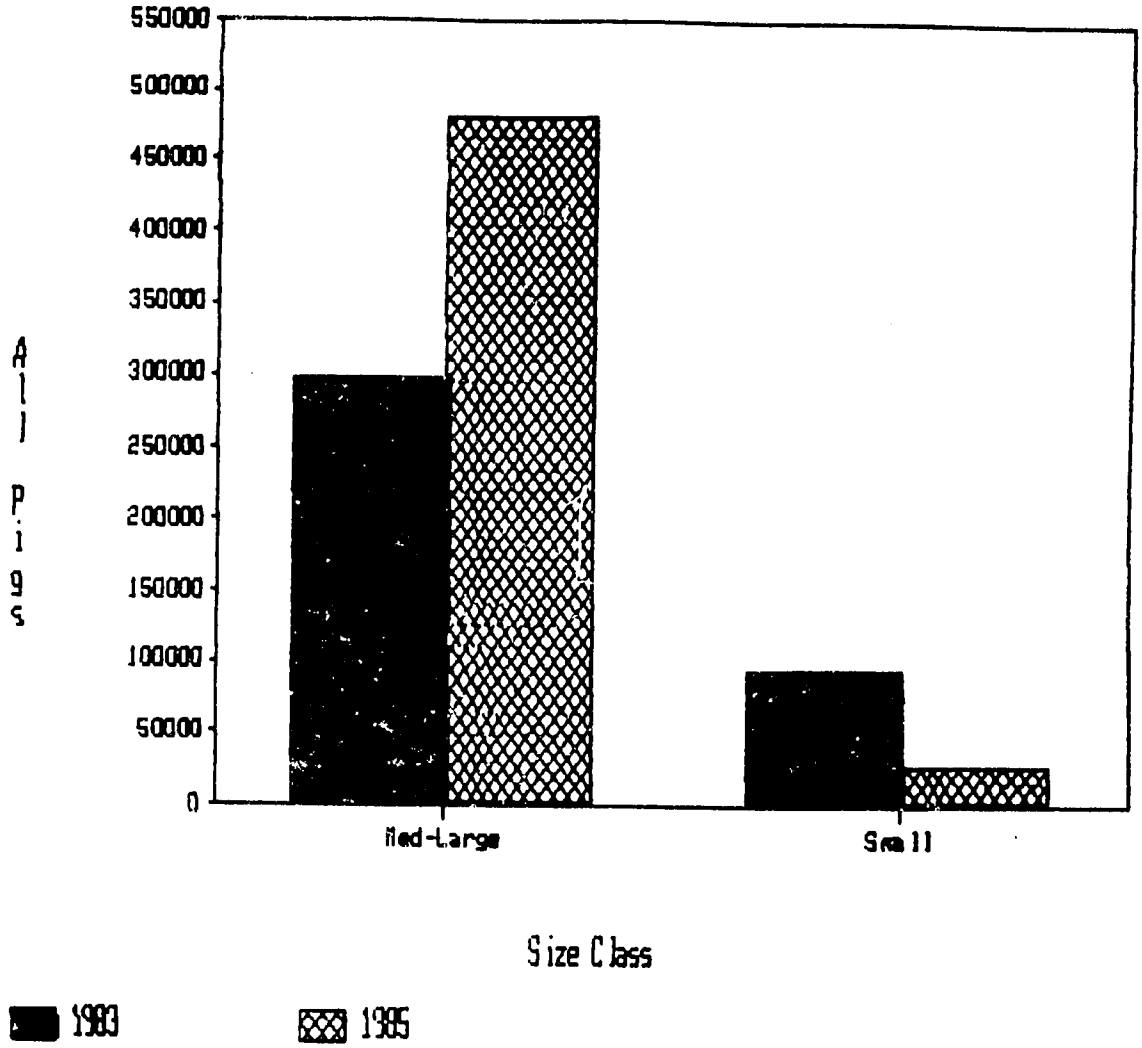

Figure 22.3. Graphical Crosstabulation of Swine Numbers for Each Farm Size Where the Year Variable is Used as a For Each Variable

Lesson 23

APPLICATION OF THE SEARCH AND CROSSTAB FEATURES OF REFLEX TO DETERMINE THE NATURE OF CHANGES IN THE SWINE INDUSTRY IN THE DOMINICAN REPUBLIC

Prepared by Art Stoecker and Elton Li

BACKGROUND

The graphical analysis of the of the data in the previous lesson (See Figure 1), indicated that while the total swine production by medium to large producers had increased significantly between 1983 and 1985, the production by provinces characterized by small producers had actually declined between 1983 and 1985. Several policy related questions arise.

1. Does the shift occur because small producers are losing money and reducing production?

2. Does the shift occur because herd size has increased and provinces which were classified as "small" in 1983 are classified as "medium-large" in 1985?

3. Are the provinces with the largest changes declines (increases) associated with lower (higher) efficiency ratios (ie pigs per litter, breeding females per male)?

Data base programs can be used to organize data to help provide answers to the above questions.

OBJECTIVES

The objective is to illustrate the use of data base features such as search and cross tab features to make data tabulations that can be used for policy research. The specific objectives are

a. Discuss the use of the Search and Filter Conditions

b. Discuss the interaction between the Search Conditions and the cross tabulation and graphic displays.

References: Borland. "The Form View," Chapter 4; "The List View," Chapter 5; "The Graph View," Chapter 6; "The Crosstab View," Chapter 7; in *Reflex: The Analyst*, Borland/Analytica, 1987.

Cobb, S. "Traditional Views: Form and List," Chapter 3; "A Select View: Filtering and Crosstabs," Chapter 4; "A Clear View: Graph," Chapter 5; in *Using Reflex: The Database Manager*, Mcgraw Hill, 1987.

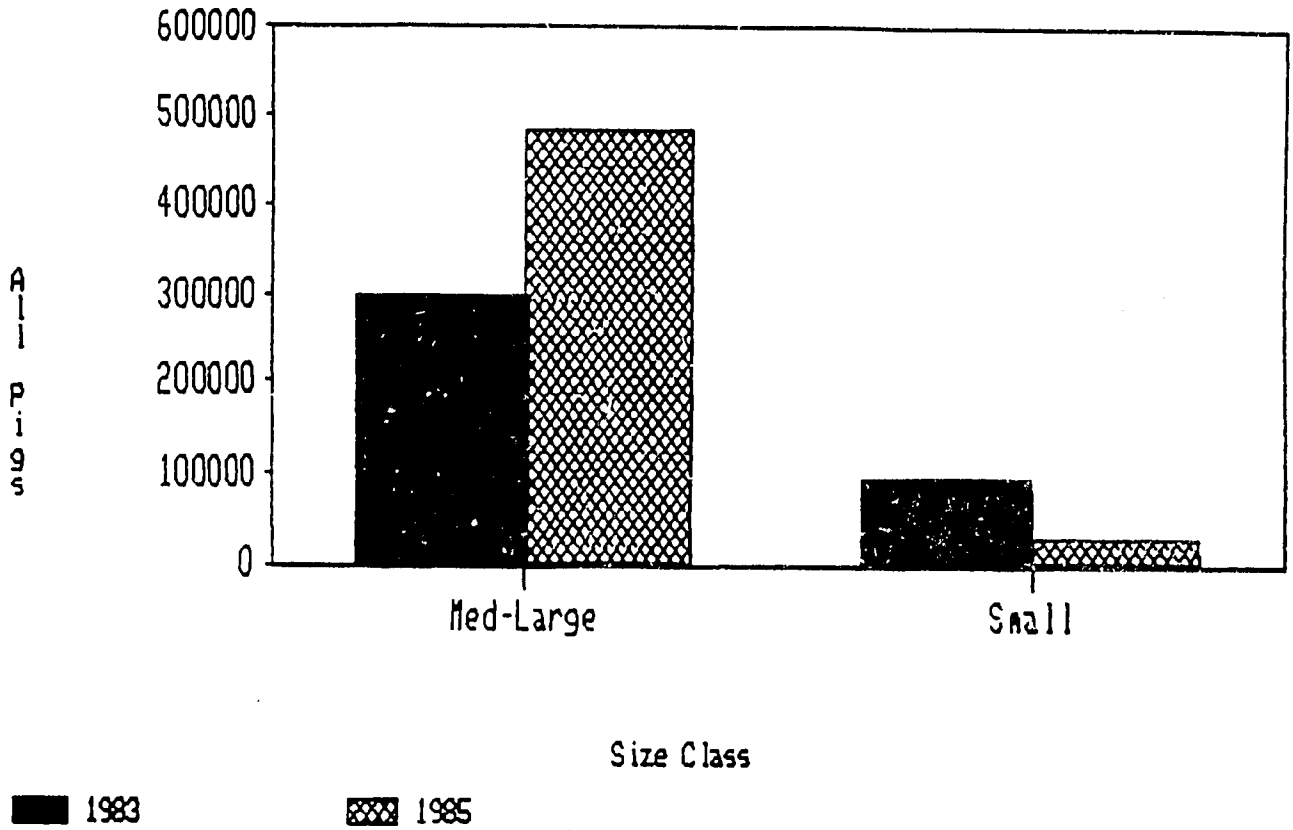

Figure 1. Number of Pigs on Farms in Small and in Medium-Large Herd Sizes in 1983 and 1985

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Use of the Search and Filter Commands

The procedure will be to develop a subset of the data records to be used in a cross tabulations.

Insert the Reflex System disk in drive A and a data disk with the data set SWDATA in drive B: At the A> prompt, ***type***

REFLEX	
/ P R	for / Print/File Retrieve
SWDATA	file to retrieve

After the data file has been loaded, the first step will be to select the subset of the data which relates to small producers. This data will be used in the cross tabulation to list out changes in the numbers of farms, total animals, and animals per farm between 1983 and 1985. The process can be repeated for the medium-large farm provinces.

The Search Option. The Search is one of the commands listed at the top of the Reflex screen. To set up the search conditions, type

/ S S for / Search Set conditions
of use the arrow keys to choose

```
Views  Edit  Print/File  Records | Search | Crosstab
                                  | Set Conditions
                                  | Apply Filter
                                  | Remove Filter
                                  | Find Record
                                  | Keep Record
```

You should see the Search Conditions Menu shown below. To select the records which relate to small producers, ***move the cursor to the SIZE CLASS field and type "Small"*** in the Condition column. Setting the search does set up the instructions for the search for records where the farms size is "Small" but does not actually do the search. ***Move the cursor to the proceed cell and press ENTER***

```
SEARCH CONDITIONS

Method of entry:  [ ] Cell  [X] Table

| Field        | Condition |
| Region       |           |
|              |           |
| Size Class   "Small"     |
|              |           |

Use: [X] Conditions as Entered  [ ] Opposite

        [Proceed]        [Cancel]
```


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To actually select the subset of records, You must apply the Filter. **Type**

/ S A for / Search, Apply Filter.

When the filter has been applied, the word

FILT appears at the lower right of the screen. The filter means that only a subset of records are available.

Using Multiple Entries in the Condition Column. You may make entries in more than one row. Additional entries in the same condition column represent an AND requirement. Only record which meet all conditions are selected. For example if you wanted a list of provinces in the Central region in the "small" size class, you would also enter "Central" in condition field for Regions as shown below.

SEARCH CONDITIONS

Method of entry: [ ] Cell [X] Table

Field	Condition
Region	"Central"
Size Class	"Small"

The above setting will select those records from provinces in the Central region in the "Small" farm class. Try it. Do not forget to type

/ S A for / Search Apply filter.

You should see only one record since there is only one case where a province in the Central region was classified in the "Small" class.

You can Remove the effects of the filter by typing

/ S R for / Search Remove Filter.

Note that as soon as the filter has been removed, the full data set reappears and the word FILT is removed from the bottom of the screen.

The OR Condition

You noticed that as soon as you made an entry in the Condition column, that another column opened up with the label OR as shown below. The OR is used if you are also want records which meet another set of conditions. For example if we want also want records for "Med-Large" farms in any of the Norcentral, Norte, Norcentral, Norte or Nordest regions we can enter

SEARCH CONDITIONS

Method of entry: [ ] Cell [X] Table

Field	Condition	OR
Region	"Central"	"Nor.."
Size Class	"Small"	"Med-Large"

The "Nor.." is a way of telling Reflex to search for any region name which begins with the letters "Nor", hence records in the Norte, Nordeste regions will be selected.

You have an alternative method of entering conditions through the cell rather than the table. Here the search condition

Region ="Norte" and Size Class ="Small"

is entered in the condition cell. This selects all records in the Norte region in the Small Size Class.

SEARCH CONDITIONS

Method of entry: [ ] Cell [X] Table

Condition [Region="Norte" and Size Class="Small"]

Use: [X] Conditions as Entered [ ] Opposite

[Proceed] [Cancel]

APPLICATION OF THE CROSSTAB WITH THE SEARCH FILTER TO ANALYZE CHANGES IN SWINE PRODUCTION

For the first step we will use all records which are in the Small Size Class. Remove the Current Filter by typing

/ S R (/ Search Remove Filter)

Go to the Search Set Conditions menu by typing

/ S S (/ Search Set Conditions)

Under the Condition column and the Size Class Row,

enter "Small". Use the Delete key to remove any other entries in the Condition or the OR columns. The search condition should appear as

SEARCH CONDITIONS

Method of entry: [ ] Cell [X] Table

Field	Condition
Region	
Size Class	"Small"

Use: [X] Conditions as Entered [ ] Opposite

[Proceed] [Cancel]

Apply the Filter by ***typing***
/ S A (for / Search Apply Filter)

Change to the crosstab view by typing
/ V X (for / Views Xtab)

Set Up the cross tab screen as shown below.

Summary Variable	***@Sum***
Field:	***Farms***
/ Crosstab For Each (row)	***Province***
/ Crosstab For Each (col)	***Year***

The data in Table 1 indicates that the number of farms with pigs in the "small" provinces has decreased dramatically between 1983 and 1985. However there are 4 provinces which are not in the "Small" group in 1985. The next question is with fewer farms with pigs, did the average herd size on the remaining farms increase? This can be answered by revising the Cross tab view by

Summary variable to ***@AVG***
Field ***Pigs per farm***

The cross tabulation in Table 2 indicates with one exception that the number of pigs per farm actually declined between 1983 and 1985 for the provinces in the Small Size Class. The status of the 4 provinces with no listing for 1985 is not clear at this point. However the results in Tables 1 and 2 indicate that the decline in production in provinces in the small category is because

a. There are fewer farms with pigs.

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Table 1. List of pigs per farm from selected list of provinces with small herd sizes in 1983 or 1985

CROSSTAB

Summary: @SUM Field: Farms

		Year 1983	1985	ALL
P	Azua	638	125	763
r	Bahoruco	752	112	864
o	Barahona	1440	136	1576
v	Dajabon	299	299	598
i	Estrelleta	189	33	222
n	Independenci	187	32	219
c	Mons.Noul	719		719
e	Monte Cristy	215	242	457
	Pedernales	122	17	139
	Pervia	306		306
	Puerto Plata	2141		2141
	Salcedo	794		794
	Samana	114	280	394
	Sanchez Rami	459	825	1284
	SanJuan	768	199	967
	Santiago Rod	222	319	541
	Valverde	469	271	740
	ALL	9834	2890	12724

b. There are fewer pigs per farm for those still producing pigs.

A similar analysis can be carried out for large producers. Type

/ S R (to remove the current filter)
/ S S (to Set Conditions)

To get to opposite selection (ie select Med-Large size Class), choose ***"Opposite of Conditions"***
Apply the Filter, type ***/ S A*** (Search, Apply Filter)

Note that the most of the data cells in the cross tab view are now empty, except for the 4 provinces which previously had no data for 1985. These provinces are now in the "Medium to Large" classification which means that the herd size increased for these provinces.

After revising the Filter, we need to **redo the *For Each*** selection on the provinces because we have a different list of provinces (those in the med-large group).

Type / C F for / Crosstab, For Each
Select Provinces (the for each variable)

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Table 2. Tabulation of pigs per farm from selected list of provinces with small herd sizes in 1983 or 1985

Summary: **@AVG** Field: **Pigs per farm**

		Year 1983	1985	ALL
P	Azua	6.46	5.47	5.96
r	Bahoruco	3.06	2.74	2.90
o	Barahona	2.61	3.29	2.95
v	Dajabon	13.19	5.95	9.57
i	Estrelleta	5.66	3.94	4.80
n	Independenci	5.26	3.41	4.33
c	Mons.Noul	11.90		11.90
e	Monte Cristy	13.05	6.74	9.90
	Pedernales	3.20	2.29	2.75
	Pervia	11.35		11.35
	Puerto Plata	13.60		13.60
	Salcedo	11.62		11.62
	Samana	10.04	9.95	9.99
	Sanchez Rami	18.28	14.36	16.32
	SanJuan	8.49	7.22	7.85
	Santiago Rod	9.13	7.84	8.48
	Valverde	13.73	9.30	11.51
	ALL	9.45	6.35	8.10

You now should have a list of the provinces which have at least one observation in the 'Med-large" group. Change the

summary variable to ***@Sum***
Field variable to: ***Farms***

The data in Table 3 indicates that the number of farms with pigs in the med-large group nearly doubled between 1983 and 1985. However, four of the provinces included in the 1985 total were in the small category in 1983. The final Table 4 on pigs per farm for the medium and large group is derived by changing the summary and field variables in the cross tab. To get Table 4 type

Summary ***@AVG***
Field ***pigs per farm***

The data in Table 4 indicates that the average herd size has declined in the med-large group as the number of producers has increased from 1983 through 1985. However the data tabulations would indicate that the expansion in numbers of swine herds in the medium-large classes are at the expense of producers in the provinces with smaller sized herds.

Table 3. Number of Farms with Pigs in the Large Size Group in 1983 and 1985

Summary: **@SUM** Field: **Farms**

		Year 1983	1985	ALL
P	Dist.Nationa	289	358	647
r	Duarte	466	974	1440
o	El Seybo	301	543	844
v	Espaillat	1284	1963	3247
i	Hato Mayor	247		247
n	La Altagraci	603	1054	1657
c	La Romana	21	40	61
e	La Vega	1624	1688	3312
	M.T.Sanchez	762	1316	2078
	Mons.Noul		464	464
	Monte Plata	493	639	1132
	Pervia		297	297
	Puerto Plata		1659	1659
	S.Pedro Maco	104	82	186
	Salcedo		976	976
	SanCristobal	297	238	535
	Santiago	682	2121	2803
	ALL	7173	14412	21585

Table 4. List of pigs per farm from selected list of provinces with large herd sizes in 1983 or 1985

Summary: **@AVG** Field: **Pigs per farm**

		Year 1983	1985	ALL
P	Dist.Nationa	214.05	199.38	206.71
r	Duarte	36.22	22.53	29.38
o	El Seybo	32.83	44.49	38.66
v	Espaillat	27.48	26.59	27.03
i	Hato Mayor	101.59		101.59
n	La Altagraci	60.47	25.08	42.77
c	La Romana	140.76	109.05	124.91
e	La Vega	24.47	38.33	31.40
	M.T.Sanchez	22.59	24.58	23.59
	Mons.Noul		33.02	33.02
	Monte Plata	31.68	32.14	31.91
	Pervia		28.45	28.45
	Puerto Plata		20.46	20.46
	S.Pedro Maco	21.79	48.72	35.25
	Salcedo		27.34	27.34
	SanCristobal	37.84	70.49	54.17
	Santiago	35.09	26.24	30.66
	ALL	60.53	48.56	53.92

Lesson 24

DESIGNING A REPORT WITH REFLEX2

Prepared by Art Stoecker and Elton Li

OBJECTIVES

The objective is to illustrate the process of generating reports from data base programs such as REFLEX. The report generator is on the REFLEX REPORT and UTILITIES disk.

Place the Report disk in drive A and type REFLEX2

You should see the following screen

```
                    Reflex: The Analyst
                    Report and Utilities

        [ Report ]                    [ Graph Print ]

        [ Translate ]                 [ File Merge ]

                    [ Exit to Dos ]
```

Move the cursor to Report, press Enter. You should see the following Report View Screen.

```
Report     Edit     Print/File     Search     Attributes

Report Design ----------------------------------------------
    ←          when printed column

               Design Area

          position numbers
                     current status indicator

Row 1 From col: 1 through Col 1                 Summary
```


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Design area. The design area is where you enter the elements you want in the report. The design area is 254 characters wide and 500 lines long.

When Printed Column. The When Printed column is used for the entry of row flags or instructions to tell Reflex how to print each row of the report. For example which rows are headings and which rows are used for each line of the report.

The Current Attribute Indicator. This indicator shows which of the attributes is used. The Summary attribute is the default when the Report View is opened.

Position numbers show the position of the cursor and define the width of any selected element. This indicates the space available for data to be printed in the field.

STEPS FOR SETTING UP A REPORT

1. Retrieve the data base. A data base or data set must retrieved before you can design a report for the data.

2. Change the sort order if necessary. The sort order affects the design of the report.

3. Enter and modify the entries in the design area. The entries in the design area include
   a. Field names from the data base
   b. additional text which is printed as entered
   c. Summarization formulas for obtaining totals, subtotals, averages etc.
   Much of the work in designing the report involves switching back and forth between the design area and the preview screen. That is you set up a design, preview the design, go back to the design area and modify the report design.

4. Change the printer settings if necessary and print the report

5. Save the report design on the disk if the report is to be printed or is to be used to generate another design in the future.

The first step is to retrieve the data base. This is done by typing

/ P R for / Print/File, Retrieve or by using the arrow keys and selecting Retrieve File from the Print/File menu shown below.

```
Report    Edit    Print/File    Search    Attributes
                  Retrieve File
                  Change Printer Settings
                  Global Settings
```

After Selecting Retrieve File,

Press the F10 key and select SWDATA

```
Report    Edit    Print/File    Search    Attributes
 Preview on Screen
 Change Sort Settings
 Display Values On/Off        ← Report menu
 Save Report Design
 Retrieve Report Design
 Erase Report Design
 Quit
```

SORTING THE DATA FOR THE REPORT

The data base should first be sorted into proper order for the report. That is, the data must be sorted into the exact order in which the individual records will be printed and subtotals will be calculated and printed.

In this example, assume the report to be printed is the one shown in Table 1. This data is in order by years (first 1983 data, then 1985 data is printed), then by regions, and then by provinces within regions. The appropriate sort order is

Year	1
Region	2
Province	3

To indicate the order of data sorting and to preform the sort

Type ***/ R C*** for / Report, Change Sort settings.

You will see a sort setting sub menu. Enter the appropriate sort values in the rows for region, province, and year as shown below.

SORT SETTINGS

Reflex Field Name	Sort #	A/D
Region	2	A
Province	3	A
Year	1	A

When finished, **move the cursor to the Proceed cell and press ENTER**

DESIGNING THE REPORT

The Objective of the Report Design is to specify the elements you want to print and the location on the page where the information is to be printed. The Report Design is similar to the Form design with the main Reflex program. The elements of the design in the when printed column control the frequency with certain records are printed and are called Row flags

Intr - Introductory material which is to be printed only one time and at the beginning of the report

Table 1. Printed Report and Comments on How Report Was Generated

Census of Swine in the Dominican Republic ← *Intr*

Provice	No. Farms	All Pigs	Pigs/Farm	Litter Size	Sows/Male ← *Head, at the top of each page*
Dist.National	289	61861	214.05	10.04	11.12
Monte Plata	493	15619	31.68	8.45	5.23
Pervia	306	3473	11.35	6.83	4.07 } *Body, one line of each record*
SanCristobal	297	11239	37.84	7.39	6.21
Central	1385	92192	73.73	8.18	6.66 ← *2-Region, printed at the end of each region contains totals and means for each region*
Azua	638	4120	6.46	5.67	5.03
Estrelleta	189	1069	5.66	5.57	2.35 } *Body*
SanJuan	768	6518	8.49	6.12	2.99
Suroeste	1595	11707	6.87	5.78	3.46 ← *2-Region*
La Vega	1624	39741	24.47	7.09	8.81
Mons.Noul	719	8554	11.90	6.28	5.64
Salcedo	794	9230	11.62	6.71	8.13
Norcentral	3137	57525	16.00	6.69	7.53
Espaillat	1284	35283	27.48	7.07	9.42
Puerto Plata	2141	29117	13.60	7.27	6.30
Santiago	682	23931	35.09	6.60	7.51
Norte	4107	88331	25.39	6.98	7.74
Duarte	466	16877	36.22	9.43	6.67
M.T.Sanchez	762	17217	22.59	6.88	7.46
Samana	114	1144	10.04	6.71	4.83
Sanchez Ramirez	459	8392	18.28	6.57	6.02
Nordeste	1801	43630	21.78	7.40	6.25
El Seybo	301	9882	32.83	6.00	4.83
Hato Mayor	247	25093	101.59	6.03	5.63
La Altagracia	603	36462	60.47	6.47	6.33
La Romana	21	2956	140.76	8.27	4.70
S.Pedro Macoris	104	2266	21.79	6.57	4.33
Este	1276	76659	71.49	6.67	5.16
Dajabon	299	3943	13.19	6.87	2.87
Monte Cristy	215	2806	13.05	7.18	5.78
Santiago Rodrig	222	2026	9.13	7.11	3.41
Valverde	469	6440	13.73	9.41	6.57
Noroeste	1205	15215	12.27	7.64	4.66
Bahoruco	752	2302	3.06	5.50	3.61
Barahona	1440	3753	2.61	5.72	4.27
Independencia	187	984	5.26	3.83	1.85
Pedernales	122	391	3.20	5.33	1.68
Sur	2501	7430	3.53	5.10	2.85
1983	17007	392689	31.58	6.83	5.46 ← *1-Year, printed at end of each year's data*

(page break — caused by @New Page)

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Provice	No. Farms	All Pigs	Pigs/Farm	Litter Size	Sows/Male
Dist.National	358	71377	199.38	7.63	9.94
Monte Plata	639	20536	32.14	7.50	4.57
Pervia	297	8451	28.45	7.32	5.56
SanCristobal	238	16777	70.49	7.79	6.96
Central	1532	117141	82.62	7.56	6.76
Azua	125	684	5.47	7.07	3.00
Estrelleta	33	130	3.94	7.00	1.80
SanJuan	199	1436	7.22	6.67	2.81
Suroeste	357	2250	5.54	6.91	2.54
La Vega	1688	64702	38.33	7.47	7.80
Mons.Noul	464	15323	33.02	7.16	6.66
Salcedo	976	26685	27.34	7.87	7.81
Norcentral	3128	106710	32.90	7.50	7.43
Espaillat	1963	52196	26.59	8.14	9.56
Puerto Plata	1659	33941	20.46	7.14	7.22
Santiago	2121	55655	26.24	7.89	6.72
Norte	5743	141792	24.43	7.72	7.83
Duarte	974	21948	22.53	7.68	2.94
M.T.Sanchez	1316	32343	24.58	7.54	7.11
Samana	280	2787	9.95	7.24	4.33
Sanchez Ramirez	825	11850	14.36	7.37	5.03
Nordeste	3395	68928	17.86	7.46	4.85
El Seybo	543	24159	44.49	7.01	6.05
La Altagracia	1054	26433	25.08	7.20	6.08
La Romana	40	4362	109.05	7.04	8.96
S.Pedro Macoris	82	3995	48.72	2.90	8.94
Este	1719	58949	56.83	6.04	7.51
Dajabon	299	1779	5.95	6.67	5.02
Monte Cristy	242	1631	6.74	5.69	4.79
Santiago Rodrig	319	2502	7.84	7.16	3.82
Valverde	271	2519	9.30	7.06	6.46
Noroeste	1131	8431	7.46	6.64	5.02
Bahoruco	112	307	2.74	6.00	1.04
Barahona	136	448	3.29	0.30	2.04
Independencia	32	109	3.41	0.00	1.17
Pedernales	17	39	2.29	0.00	2.00
Sur	297	903	2.93	1.58	1.56
1985	17302	505104	29.63	6.33	5.39 ← *1-Year*
Two Year totals	34309	897793	30.63	6.58	5.42 ← *Conc, conclusion contains totals and means over both years*

Head - Headings which are to be printed below and introductory material but near the top of each page.

Body - A line of information which is to be printed one time for each record in the report.

1-first sort var A line of information is printed when the value of the first sort variable changes. In our example this is the year.

2-second sort var A line of information is printed when ever the value of the second sort variable changes (eg regions) changes.

The information in the Design area consists of

Text : these are labels such as column headings, report names

Fields: Locations where values form the data set are to be printed.

Totals, averages, counts etc of the data. This is where column total or sums of variables over different records are obtained.

The Design Screen which was used to generate the information in Table 1 is shown below. Study the Relationship between the information in Table 1 and the control information shown in the Design Screen below.

Row	Report	Edit Print/File Search Attributes					
	Report	Design ----------					
1	Intr						
2	Intr	'Census of Swine in the Dominican Republic					
3	Intr						
4	Head						
5	Head	Province	No.Farms	All Pigs	Pigs/Farm	Litter Size	Sows/male
6	Head						
7	Body	Province	Farms	All pigs	Pigs por F	Litter Size	Prod sow
8	2-Reg	Region	@Sum(Farm	@Sum(All p	@AVG(Pigs	@Avg(Litter	@AVG(Prod
9	2-Reg						
10	1-Yea	Year	@Sum(Farm	@Sum(All p	@AVG(Pigs	@Avg(Litter	@AVG(Prod
11	1-Yea	@New Page					
12	Conc						
13	Conc	Two Year Totals					
14	Conc		@Sum(Farm	@Sum(All p	@AVG(Pigs	@Avg(Litter	@AVG(Prod

To begin the form design, Position the cursor in the top row, ***Press the F3*** (row select Key). This will move the cursor into the As Printed Column.

Type Intr (to leave a blank row)

or

Press F10 ***Select Intr, Press Enter***

In row 2, ***Press the F3 key Type Intr,***

Use the left arrow key to move into the Design Area

Type in the Title, 'Census of Swine in the Dominican Republic

Row 3: ***Press the F3 key, Type Intr*** (To leave a blank row)

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Row 4: ***Press the F3 key, type Head*** (To leave a blank line)

Row 5: ***Press the F3 key, Type Head*** <---labels for column headings (note that each heading begins with a single quote)
Move the cursor to the design area
Type 'Province <cr> leave 2 spaces
Type 'No. Farms <cr> leave 2 spaces
Type 'All Pigs <cr> leave 2 spaces
Type 'Pigs/farm <cr> leave 2 spaces
Type 'Litter size <cr> leave 2 spaces
Type 'Sows/male <cr>

Row 6: ***Press the F3 key, Type Head*** (To leave a blank line)

Row 7: ***Press the F3 key, Type Body*** <-- print for each record
Move the cursor to the Design area
Press F10 select Province, <cr> leave 2 spaces
Press F10 select Farms,<cr> leave 2 spaces
Press F10 select All Pigs <cr> leave 2 spaces
Press F10 select Pigs per farm <cr> leave 2 spaces
Press F10 select Litter size <cr> leave 2 spaces
Press F10 select Sows per male

You should "Preview the report" by typing
/ R P for / Report Preview on Screen

Row 8: ***Press the F3 key, type 2-Region*** <-- print for each new region
Press F10, Select Region, <cr> leave 2 spaces
Press F10, Select Farms <cr> Press F10 Select @Sum
Press F10, Select All Pigs <cr> Press F10 Select @Sum
Press F10, Select Pigs per farm <cr> Press F10 Select @AVG
Press F10, Select Litter Size <cr> Press F10 Select @AVG
Press F10, Select Prod sow per male <cr> Press F10 Select @AVG

Row 9: ***Press the F3 key, type 2-Region*** <-leave a blank line

Row 10: ***Repeat the process for 7, except type 1-Year*** in the as printed column

Row 11: ***Type 1-Year in the As Printed column, move the cursor into the design area, Press F10 Select @New Page*** (to force a new page after the total for the year is printed)

Row 12: Enter Conc in the As Printed Column

Row 13: Enter conc in the As Printed Column, enter the title 'Two year totals in the Design Area

Row 14: Repeat the process for row 8, except the "year" field is omitted.

Preview the report on the screen. ***Type***

/ R P <-- for Report, Preview.

After the report appears correctly on the screen, it is ready for printing. The Print command is in the Print/File menu. However you should check the margins other parameters for the printer. ***Type***

/ P C <-- for Print/File, Change Printer Settings

You will then see the printer setup menu shown below. Check the printer settings. When the settings are correct, move the cursor to the Print box and press Enter to print the report.

Print Settings

Title Line 1 _____

Title Line 2 _____

Output [X] To Printer [ ] To Disk File

Margins Left [2] Right [74]

Top [2] Bottom [6]

Page Length [66] Setup String [ ]

Paper Feed: [X] Continuous [ ] Single Sheet

Print Page [1] To [100]

[Print] [Put Away] [Cancel]

Save Report Design. After you have finished printing, you should save the Report Design you have created. The report design file will contain instructions on how to print a specific data set but does not contain the actual data. In fact you may have several report designs for a given set of data. Each report design presents a different part of the same data.

Type / R S <--- for Report, Save Report Design.

You will be asked to supply a name for the report design. This can be the same name as the data set as Reflex will supply a different extension to the name.

Quitting Reflex Report. After you have save the report design and have finished printing, you can quit Reflex2 Report by ***typing***

/ R Q <--- for Report, Quit. You will see the prompt,

Are You Sure? |No| |Yes| <-- ***Select Yes*** and you will return to the

opening menu where you can exit to DOS.

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Lesson 25

TRANSLATING A LOTUS 1-2-3 FILE TO REFLEX

Prepared by Elton Li and Art Stoecker

OBJECTIVES

Although Lotus 1-2-3 is a powerful package suitable for many data handling and analytical operations, there are times when it is not the best tool for the job. For example, in the regional production database we worked with in Lotus, where each record corresponds to a production record associating with a crop for a region for one year, and the fields of each record are:

```
CROP  REGION  YEAR  PLANTED_AREA  HARVESTED_AREA  PRODUCTION  YIELD
```

We have seen that how data in the database can be sorted and how simple database queries can be made. However, Lotus, being by nature a spreadsheet package, has rather weak database facilities. In particular, it can only sort on two fields, one primary and one secondary, e.g. CROP and REGION, or CROP and YEAR. In this particular example, it is useful to be able to sort on three fields, namely CROP, REGION and YEAR. But the LOTUS sort facility would not let us do that.

Also, the /Data Query command in Lotus is somewhat cumbersome in the way the criterion must be specified. Moreover, generating crosstabs would require a lot of effort with LOTUS. The reporting facilities of LOTUS are also weak to non-existent.

The aforementioned weaknesses of LOTUS are precisely the strength of database programs like REFLEX. A common situation occurs when you have your data coded in a package (in this case LOTUS) and another package (in this case REFLEX) contains a few features which are more suitable for your current analytical needs. Luckily many popular packages contain translation facilities allowing their own files to be translated to other packages, and vice versa. Since LOTUS is perhaps the most popular package, most other programs, including REFLEX, provide a facility to translate LOTUS files to their own native format. This lesson provides some practice with this facility.

References: Borland. "Using Reflex with Other Software Products." Chapter 13 in *The Analyst*. Borland Inc., 1987.

Cobb, S."Relating Reflex to Other Programs." Chapter 8 in *Using Reflex: The Database Manager*. Borland-Osborne/McGraw-Hill, 1988.

PROCEDURE

(1) We will work with the LOTUS worksheet named DATAX. ***Start up LOTUS in the usual manner and load the file DATAX.*** This is the same data set we have worked with in the lesson on the database facilities of LOTUS. The database area is contained in the range A1.G147. Column A to G contains crop code, region code, year, planted area, harvested area, production and yield, respectively. All data are numeric, including the crop code and region code. Regions are numbered from 1 to 8

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with 9 representing the nation as a whole. Yields are calculated with the formula PROD/HARV.

Observe and remember the following:

— Row 1 contains the heading of the data base, thus the actual data span the area A2 to G147. The last column (G), YIELD, is a calculated column.

— Below row 147 are some criterion ranges and output ranges. These areas are not part of the database and should not be included in the translation to be performed below.

— The entire area of the worksheet, including the "junk", thus spans from A1 to G183. However the data we will transfer is included in the range A2.G147.

(2) ***Quit LOTUS***, and if you have not already done so, ***use CONV*** to ***conv DATAX*** to be fully compatible with LOTUS version 2A. REFLEX will not accept LOTUS student version files. The CONV program is described in Appendix A.

(3) ***Now insert the Reflex report and utilities disk in drive A*** and invoke ***REFLEX2***. When it comes up, ***choose the TRANSLATE*** feature.

(4) The first thing TRANSLATE needs to know is the FILE TYPE you are transferring from. ***Use the F10 key*** to bring up a menu of choices. As you can see, the REFLEX translate facility can translate a variety of file types into its own native format. In particular, it can translate dBase files, LOTUS files and Symphony files. In our case we will ***choose 1-2-3 v2.0*** (Do not choose the item with just 1-2-3 on it). If you ever need to translate other kinds of files, check out Chapter 13 of the REFLEX manual.

(5) After you have chosen the FILE TYPE, REFLEX then expects you to specify the ***From File***. In our case, this should be ***B:DATAX***. Once this is specified, REFLEX gives you a screen full of information.

(6) Examine this information. First of all, REFLEX automatically fills in the To File area also. Thus REFLEX by default names To File the same as From File. But these are not the same files since they have different extensions. Thus the full name of the From File is actually DATAX.WK1 and that of the To File is DATAX.RXD (Wk1 and RXD are files extensions for LOTUS full version and REFLEX files respectively). This is almost always acceptable. But if not, feel free to change the To File to whatever valid name you want (do not specify the extension).

(7) Look at the screen carefully again. The "***Translate: From...To...cells***" specify the coordinates of the entire area of the Lotus worksheet, in this case, as observed in (1), this ***should be A1 to G187***.

(8) Towards the bottom of the screen there is a table which we will called the translate table. In our case it has the entry

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Position	has value of	Type	Reflex Field Name	Type	Include?
A1	CROP	Text	CROP	Text	Yes
B1	REGION	Text	REGION	Text	Yes
C1	YEAR	Text	YEAR	Text	Yes

Observe, but do not perform, the following:

— The "Show Data from Row" identifies the row currently displayed in the "Position" and "Has Value Of" columns of the translate table. Reflex displays the first row of data in the spreadsheet. To display any other row of the spread sheet, simply enter the row's number in this cell. Try! But change it back to 1 before continuing.

— The "Position" column lists the coordinates of the spreadsheet cells in the row specified in the "Show Data from Row" cell.

— The "Has Value of" lists the values of the spreadsheet cells in the row specified in the Show Data from Row cell. These are the actual values stored in the spreadsheet. In our case, cell A1 contains the label (or text) CROP, B1 contains the label (or text) REGION, and C1 contains the label (or text) YEAR. The translate table can only show a part of the fields. Move the cursor down to the table and scroll to see the others.

— The first "Type" shows the data type of the spreadsheet cells in the specified row. In our case, row 1 of the spreadsheet are all labels (or text).

— "Reflex Field Name" lists the field names the spreadsheet will be translated into. Initially, these entries are the same as those in the "Has Value of column." This is usually acceptable. To change field names, simply highlight the cell and enter the new name.

— The second "Type" gives the data type of each translated cell. These are the same as those given in the source file and shown in the first Type column. To change the data type of any of the fields, highlight the cell and use F10 to enter a new type.

— "Include" tell REFLEX whether or not to include columns in the present spreadsheet in the translated file. Sometimes we will not want to keep all the columns. To exclude a column, highlight the corresponding cell in this column and type NO.

(9) By default, REFLEX assumes you want to translate the whole spreadsheet. Thus it displays "From A1 to G183". However, as mentioned in (1) the database only span from ***A2 to G147. So change this.***

(10) ***Now change "Show Data From Row" to 2.*** The first three columns of the translate table now contains information pertaining to row 2 of the worksheet. In particular, the first "Type" column are showing all numeric. Now the second "Type" column, which is the type that REFLEX will assume for the data, are all wrong, since they are all displaying text. This is because the headings were all text. But we are not concerning about the type of the headings, we are concern about the type of the data. ***To make the second "Type" column the same as the first "Type" column, invoke the menu and select type.***

(11) Also by default, REFLEX will include all the columns in the translation. This is indicated by "Yes" all through the "Include?" column. But we don't want that here. The reason is that since the yield field is a calculated field in LOTUS, we want to manually supply the equivalent formula in REFLEX. If we had included the YIELD field, the formulas will not be translated, only the values. Thus it is better to exclude this field in the translation, and define YIELD later in REFLEX. ***So move to the "Include" field and type in No.***

(12) Now we are ready to translate. ***Thus move the cursor to "Translate" and press enter.*** The translation process should take a few seconds. "Partial Translate" allows us to specify a filter during the translation thus only allowing, say, 1987 data to go to REFLEX. Specifying this filter is very much similar to specifying filters elsewhere in REFLEX.

(13) ***Exit TRANSLATE and REFLEX2.*** Then go to ***REFLEX*** and check this dataset out. Define the YIELD field appropriately and then save the datatset.

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Appendix A

CONV: A PROGRAM TO CONVERT LOTUS 1-2-3 STUDENT VERSION FILES TO LOTUS 1-2-3 RELEASE 2 COMPATIBLE FORMAT

Developed by Elton Li

Worksheet files created by the student version of Lotus 1-2-3 cannot be read by the full version of Lotus 1-2-3. Nor can they be used by other software packages which accept Lotus files (e.g. Reflex). CONV overcomes this difficulty by producing a full version Lotus 1-2-3 file from a student version file.

Lotus student version file has WKE as extension in contrast with the full version's WK1. Merely renaming a student version file, say, from DATA.WKE to DATA.WK1 will not make it full version compatible. A WKE file differs slightly from a WK1 file in its internal organization. CONV reads the WKE file, adjusts its internal organization, and produces a WK1 suitable for use by the full version.

CONV can be run at the DOS prompt level by the command:

CONV <filename>

where <filename> is the name of a student version file <u>without the extension part</u>. CONV will not alter this student version file, but rather outputs another file with the same name but with extension WK1.

Assuming a 2 drive system with CONV in drive A and the data disk containing the file you want to convert, say DATA.WKE in drive B. The appropriate command to issue is then:

CONV B:DATA

CONV then reads in DATA.WKE from drive B, converts it, and outputs it to the file DATA.WK1 in drive B. The original file, DATA.WKE is neither changed nor deleted after this operation.

If you desire to name the output file a different name other than DATA, then CONV can be invoked in the form:

CONV <InFileName> <OutFileName>

For example:

CONV B:DATA B:NEWDATA

will convert DATA.WKE from drive B and produces NEWDATA.WK1, again in drive B. If instead

CONV B:DATA NEWDATA

is issued, then NEWDATA.WK1 will be stored in the default drive, most likely drive A.

Make sure there is sufficient space to store the output data set. If you run out of space to store the new file, CONV will complain and stop. However it will not automatically delete the partially converted output file. You must then delete that incomplete file and attempt the conversion again with a diskette with has sufficient space.