A SOFTWARE PACKAGE FOR TEACHING FARM PLANNING

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Abstract

"Finding Your Agricultural Advantage" is a collection of four programs—one to generate case studies, one to do "trial-and-error" solutions, one to display linear programming solutions, and one to maintain case study data files. The four programs can be used together or individually as instructor preferences dictate in teaching farm planning. A step-by-step method for teaching with the software is presented as an example of its use.

Key words: linear programming, microcomputers, case studies, alternative crops.

The Federal Cooperative Extension Service, recognizing the renewed interest in farm planning for alternative crops, established a National Task Force on Comparative Advantage and Competitiveness. The Task Force worked throughout 1987 to develop new materials for teaching basic economic concepts in planning at the farm, regional, and national levels (Ikerd et al.). It was decided early that a computer approach which could be used in teaching farmers some of these concepts at a relatively introductory level would be valuable. The software described here, "Finding Your Agricultural Advantage," became a product of the Task Force.

The Task Force agreed that the software package should be very easy to use, general enough to be used throughout the United States, and flexible enough so that instructors could use it in many different teaching situations. We therefore chose to design a collection of programs that could be used separately or in concert. The separate programs could make case studies, support "trial and error" solutions to the cases, and demonstrate the use of linear programming (LP). The case study generator was programmed so instructors could set up cases which illustrate many important phases of farm planning.

LITERATURE REVIEW

The most common computer approach to the classic problem of choosing which crops will maximize returns for a given resource base is linear programming. LP has been used successfully for direct analysis of real situations in such cases as the Purdue "Top Farmer" program (McCarl et al.). The Task Force agreed that linear programming would play an important role in solving case examples, but the extent to which LP would be taught for its own sake was less clear. Laughlin and Beilock et al. have reported successful microcomputer applications for teaching LP in classroom settings. The approach here, however, was to enhance instruction by county agents in typical Extension environments. Using LP solutions to teach farm planning concepts, rather than the teaching of LP, became the central focus of this software package. We therefore designed an LP software component which could be used by those with no formal training in LP. The simulation and gaming approaches suggested by Babb and Levins et al. were also given serious consideration.

Both Babb and Levins et al. have reported that gaming and simulation computer methods can be powerful educational tools. To capture some of these benefits, we decided to allow for traditional trial-and-error solution techniques in addition to optimization methods. A straightforward spreadsheet was therefore included for generating farm plans. Spreadsheets have become a mainstay of farm management software, and their familiarity to users was seen as an important advantage.

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A third computer approach which proved useful was that reported by Levins and Brown. They argued that in teaching applications there are often more analytical techniques than there are real cases to analyze. The "Dairy Expert" software they describe included software to generate case studies of dairy herds which students could examine for deficient management practices.

OVERVIEW OF PROGRAMS

"Finding Your Agricultural Advantage" is a collection of four programs—one to generate case studies, one to do "trial and error" solutions, one to display LP solutions, and one to maintain case study data files. As is shown in Figure 1, both spreadsheet and Pascal programming methods were used to make the overall operation of "Finding Your Agricultural Advantage" as simple as possible.

The first of the four programs shown in Figure 1 prints a case study for a hypothetical farm. Each time this program is run, a new set of resources, costs, and returns is generated. The program also generates the LP solution for the case study and saves it on the disk.

Case study farms such as the one shown in Figure 2 are generated with a one-word command for DOS. The first page of the case study describes the resources—land, labor, and capital—which are available to the farm. The remaining one or two pages of the case study give information on the crops which can be selected for the plan. Each crop has a different yield and net return for each of two soil types, but the price, costs, and labor requirements are the same for the two soil types. Maximum acreage constraints are given for each crop based on markets, equipment capacity, or crop rotations. The crop costs include only selected variable expenses for growing the crops. It is assumed that such overhead costs as land and machinery must be covered regardless of the crops selected.

The second of the four programs is a spreadsheet which helps in choosing a profitable cropping plan for the case study farm by trial-and-error methods. A Lotus spreadsheet called "PLAN" is included on the program diskette.

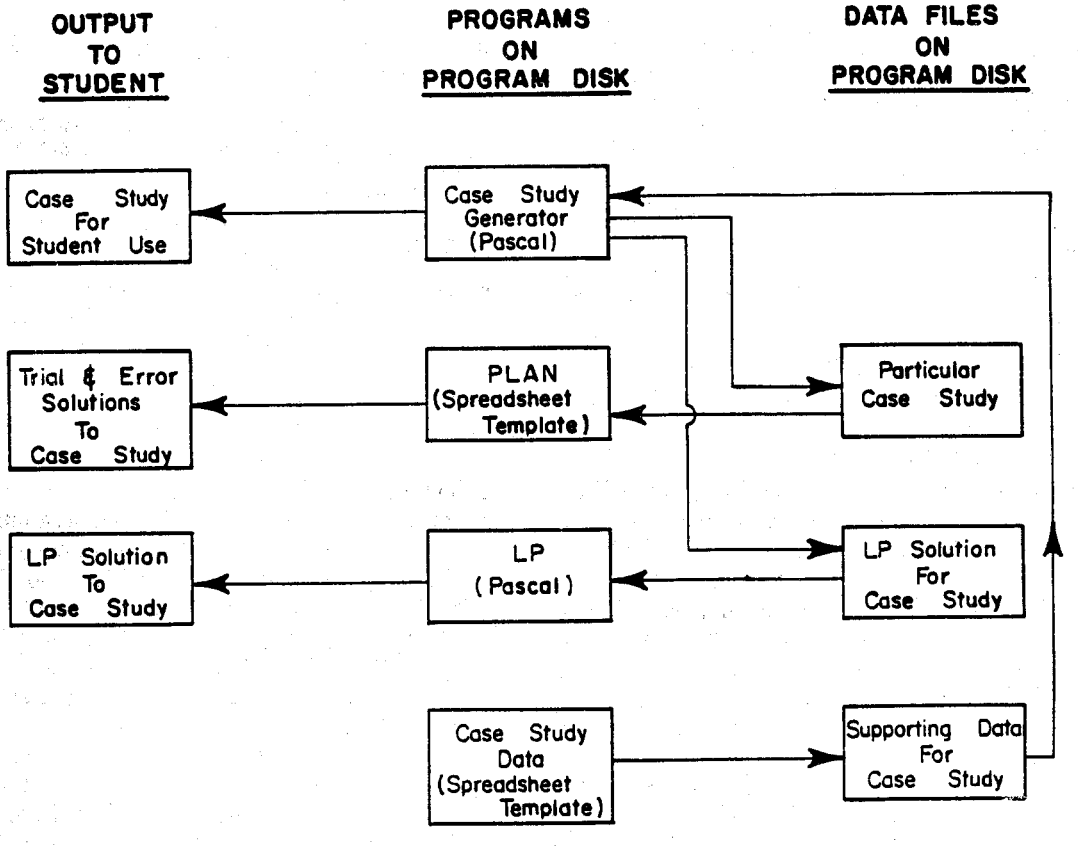

Figure 1. Overview of the "Finding Your Agricultural Advantage" Software.

Finding Your Agricultural Advantage
A Case Study for Practice

Welcome to Finding Your Agricultural Advantage. This case study is designed to give you practice in finding profitable alternatives for a specific farm. As with a real farm, you have certain resources to work with and certain alternatives you can try. You can choose only alternatives that do not exceed the resources you have to work with. For this farm, you must decide which crops to plant and how many acres of each to plant. You will not be charged for family labor, but hired labor will be charged at the stated rate. You cannot get more labor than the maximum amounts specified.

Here are the resources you have to work with:

There are 500 acres of tillable land. Of these acres, 250 acres are Soil Type I and 250 acres are Soil Type II.

For each three-month period, family labor cannot exceed 1040 hours.

Extra labor can be hired at $5.00 per hour.

For March-May, hired labor cannot exceed 780 total hours.
For June-August, hired labor cannot exceed 1300 total hours.
For September-November, hired labor cannot exceed 780 total hours.
For December-February, hired labor cannot exceed 780 total hours.

Cash and credit used cannot exceed $75,000.00.

CROPS INFORMATION

CORN Price/BU: $2.00
Yield (BU/acre) Soil Type 1: 105 Soil Type 2: 78
Costs ($/ac) Seed $19.80 Fert $59.00 Chem $16.50 Other $35.00
Total Cost $130.30
Net Over Costs ($/acre): Soil Type 1: 79.70 Soil Type 2: $25.70
Labor (hrs/acre):
Mar-May 2.0 June-Aug 1.0 Sep-Nov 2.0 Dec-Feb 0.0
Markets, equipment, or crop rotations limit you to 500.0 acres.

SOYBEANS Price/BU: $5.00
Yield (BU/acre) Soil Type 1: 33 Soil Type 2: 28
Costs ($/ac) Seed $13.50 Fert $32.60 Chem $12.70 Other $30.00
Total Cost $88.80
Net Over Costs ($/acre): Soil Type 1: $76.20 Soil Type 2: $51.20
Labor (hrs/acre):
Mar-May 2.0 June-Aug 1.0 Sep-Nov 2.0 Dec-Feb 0.0
Markets, equipment, or crop rotations limit you to 500.0 acres.

ALFALFA HAY Price/TON: $70.00
Yield (TON/acre) Soil Type 1: 4 Soil Type 2: 3
Costs ($/ac) Seed $15.00 Fert $51.00 Chem $23.00 Other $21.00
Total Cost $110.00
Net Over Costs ($/acre): Soil Type 1: $170.00 Soil Type 2: $100.00
Labor (hrs/acre):
Mar-May 2.0 Jun-Aug 6.0 Sep-Nov 2.0 Dec-Feb 0.0
Markets, equipment, or crop rotations limit you to 500.00 acres.

TOMATOES Price/TON $800.00
Yield (TON/acre) Soil Type 1: 5 Soil Type 2: 3
Costs ($/ac) Seed $232.00 Fert $65.00 Chem $51.00 Other $391.00
Total Cost $739.00
Net Over Costs ($/acre): Soil Type 1: $3261.00 Soil Type 2: $1661.00
Labor (hrs/acre):
Mar-May 35.0 Jun-Aug 185.0 Sep-Nov 3.0 Dec-Feb 0.0
Markets, equipment, or crop rotations limit you to 5.0 acres.

PEPPERS Price/CRATES: $10.40
Yield (CRATES/acre) Soil Type 1: 145 Soil Type 2: 108
Costs ($/ac) Seed $184.00 Fert $72.00 Chem $28.00 Other $289.00
Total Cost $573.00
Net Over Costs ($/acre): Soil Type 1: $935.00 Soil Type 2: $550.20
Labor (hrs/acre):
Mar-May 3.0 June-Aug 55.0 Sep-Nov 74.0 Dec-Feb 3.0
Markets, equipment, or crop rotations limit you to 5.0 acres.

Figure 2. Example Case Study Generated by the Software.

When PLAN is loaded, a screen similar to the one shown in Figure 3 is presented. Information from the last case study generated with the program disk is automatically read into the spreadsheet. As the crop acreage combinations are entered, this section will summarize the resources used and calculate the remaining unused resources.

There are three parts to the PLAN spreadsheet. Part 1, shown in Figure 3, is a general overview of the farm plan. Part 2 is a labor summary in which the labor requirements for each crop are shown for each of four three-month time periods. At the bottom of the labor screen, information is given on the amount of family and hired labor available in each of the periods. Part 3 is a summary of the income and expenses. Receipts, non-labor costs, and the difference between the two for each of the crops are shown. The total returns over non-labor costs are calculated for the farm plan and then hired labor expenses are subtracted to get the net return.

The third of the four programs in "Finding Your Agricultural Advantage" reads the LP solution from the program disk and displays it on the screen. A one-word command from DOS will show the net returns for the last

case generated on the disk. The acreage of each crop planted on each soil type for the optimal solution is also shown.

The case study generator reads files containing crop and resource information each time a case is made. These files can be changed by the user with the final "Finding Your Agricultural Advantage" program so that cases made by the program reflect local conditions and the particular points an instructor may be trying to teach. How these changes are made is described in the next section.

INPUT REQUIREMENTS

Users (typically instructors) can develop and maintain files on resources, crop budgets, and random parameters by using a series of Lotus spreadsheets which are accessed through a spreadsheet called "MENU." If the user elects to "Change Resources" from the spreadsheet MENU, any of the following values can be entered or edited: acreage of two soil types, family and hired labor available in four time periods, upper limit on operating capital, and hourly rate for hiring labor.

Crop budget information can be changed with another menu selection. Again using familiar spreadsheet techniques, the user can enter/edit the number and names of crops in a case, yields, prices, costs, and labor requirements. A maximum number of acres for each crop can also be specified to reflect market or equipment constraints. The costs are specified so they can be easily transferred from FINPACK (Hawkins et al.) data banks already maintained in many states.

Case study farms are made by using the resource levels found in the resource file and the price, cost, and yield information found in the crop file. These data are randomly altered within a certain range each time a case is made. These random ranges can be controlled by accessing the parameters file through the spreadsheet MENU. In the example screen shown in Figure 4, the "% RANGE IN PRODUCT PRICES" of 30 means that prices for each crop will vary by plus or minus 30 percent from the prices in the crop file. All prices within the range are equally probable. The randomization of case studies can be suppressed for any resource or value by specifying a range of zero percent.

All data entry is handled within Lotus. In this way, full advantage is taken of both the general familiarity of the Lotus interface and its extensive error-handling procedures. The Pascal programs "CASE" and "LP" require no input from the user other than a DOS command to start them.

PARAMETERS	COEFFICIENT
% RANGE IN PRODUCT PRICES	30
% RANGE IN YIELDS	30
% RANGE IN COSTS	10
% RANGE IN SOIL ACREAGE	50
% RANGE IN LABOR AVAILABLE	50
% RANGE IN CASH AND CREDIT	50

Figure 4. Example of Parameter Entries.

TEACHING APPLICATIONS

There are many ways the "Finding Your Agricultural Advantage" programs can be used in teaching. A step-by-step method is illustrated here which instructors can use as is or modify

PART 1-PLAN

CROP	TYPE 1 ACRES	TYPE 2 ACRES
CORN	110	
SOYBEANS		250
ALFALFA HAY	130	
TOMATOES	5	
PEPPERS	5	
BLANK		
BLANK		
BLANK		
BLANK		
BLANK		
BLANK		
BLANK		
GROSS INCOME		$122,040
TOTAL EXPENSES		$ 66,168
NET RETURN		$ 55,872

RESOURCE AVAILABILITY AND USE

	LAND USE (ACRES) TYPE 1		TYPE 2	
LAND AVAILABLE	250		250	
PLAN USE	250		250	
UNUSED LAND	0		0	
			PERIOD	
	1	2	3	4
LABOR AVAILABLE	1820	2340	1820	1820
PLAN USE	1170	2340	1365	15
UNUSED LABOR	650	0	455	1805
OPERATING CAPITAL				
AVAILABLE	$75,000			
PLAN USE	$66,168			
UNUSED CAPITAL	$ 8,832			

ERR - INDICATES INFEASIBLE RESOURCE USE

Figure 3. First Screen of the PLAN Spreadsheet.

as circumstances may require. The steps are written for teaching important points about adopting alternative crops. Applications in areas of labor and capital constraints can be handled similarly.

Instructors should always begin by making sure the crop and resource data files are set up for situations the students will find familiar. Then a case study should be generated and copied for each student. The students should be asked to make a cropping plan for the case study and explain their reasons for choosing it.

Beginning students must now be shown the necessary calculations to make sure their plans are feasible. The program manual (Levins and Johnson) shows how to do these calculations by hand, or the PLAN spreadsheet can be used effectively with a "live" display in group meetings. Once several feasible plans have been identified, the LP solution can be shown as an indication of how close each person's plan was to maximum profits.

The discussion should now begin to focus more on high-valued alternative crops. For this exercise, there should be at least one or two high-return crops in the crop file. These crops should also have high labor and capital requirements. The instructor should run several case studies, print the LP solutions for each, and discuss why crops with the highest per acre returns are not always dominant in crop plans. This provides an excellent setting for introducing the economic concept of opportunity cost.

The next concept to be addressed is that farms with different resource bases require different crop plans. By setting the parameters for range in product prices, range in yields, and range in costs to zero, many cases with different resources but identical crop budgets can be generated. Comparing the LP solution for each case provides the entry point for discussion.

Similarly, the effect of changing budgets on a particular farm can also be discussed. In this exercise, the ranges in acreage, available labor, and cash and credit are set to zero. The price, yield, and cost ranges should be nonzero. Each case study generated with these parameters will have identical resources. Returns from each crop, however, will vary. The LP solutions for these cases can be compared and discussed.

FIELD TESTING

"Finding Your Agricultural Advantage" was developed over a nine-month period during which members of the National Task Force on Comparative Advantage and Competitiveness provided valuable guidance and suggestions. The program was intended for use in all 50 states from the outset, so it has been presented at two national workshops and made available to Extension specialists attending. The authors have also used the program in county agent training and in farmer workshops. The program was well received in all cases.

Field tests showed the software to be especially well adapted to use in meetings with computer screen projection equipment. Screen displays for PLAN and the LP solution are designed to present information in logical segments. Time requirements to use the PLAN and LP programs are minimal, so there is no delay in meetings. Setting up the case data base should take no more than an hour or two, especially if FINPACK data banks are available. Generating a case and LP solution requires about five minutes once the supporting data have been entered.

AVAILABILITY

"Finding Your Agricultural Advantage" requires an IBM-PC, XT, AT, or compatible with at least 256K RAM, one floppy disk drive, and an Epson-compatible printer. PC-DOS or MS-DOS, version 2.0 or higher, is also required. The user must have Lotus 1-2-3 or a compatible spreadsheet program to use the second and fourth programs shown in Figure 1. The program disk and user manual (Levins and Johnson) are being distributed and supported by the Georgia Cooperative Extension Service in Athens, Georgia.

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