United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

NE-GTR-116

PC-SOLVE II User's Manual:

A Procedural Guide for the Microcomputer Version of SOLVE II Sawmill Analysis Tool

Edward L. Adams

Abstract

A procedural guide for using the PC-SOLVE II system for analyzing hardwood sawmills. PC-SOLVE II is a microcomputer version of the original SOLVE II system. It requires the same input data and provides the same output information. All that is required to use the new system is an IBM-PC or compatible microcomputer that (1) has 512K of resident memory, (2) uses Microsoft disk operating system (MS-DOS) Version 2.0 or greater, (3) has at least one floppy disk drive, and (4) is attached to a printer.

The Author

EDWARD L. ADAMS is a forest products technologist with the Northeastern Forest Experiment Station's Forestry Sciences Laboratory at Princeton, West Virginia. He received a B.S. degree in forest management and an M.S. degree in forest mensuration at West Virginia University. He worked for the USDA Forest Service in Oregon from 1960 to 1963 and joined the Northeastern Station in 1968.

Manuscript received for publication 17 September 1986

Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA 19008
April 1987

PC-SOLVE II[1] is a modified version of the original SOLVE II system for analyzing hardwood sawmills. Developed to eliminate the need for a mainframe computer, it requires the same input data and provides the same output information as the original version. However, PC-SOLVE II is to be run on an IBM-PC[2] or compatible microcomputer that (1) has 512K of resident memory, (2) uses Microsoft disk operating system (MS-DOS) Version 2.0 or greater, (3) has at least one floppy disk drive, and (4) is attached to a printer. A hard disk drive also can be used with the system.

This manual is to be used in conjunction with the two original SOLVE II publications: (1) "SOLVE II: a technique to improve efficiency and solve problems in hardwood sawmills" (Adams and Dunmire 1977), and (2) "SOLVE II user's manual: a procedural guide for a sawmill analysis" (Adams and Dunmire 1978). The first provides a general discussion of the system. The second provides instructions for collecting and entering the study data onto SOLVE II data sheets. This manual provides instructions for entering the data into a data file and processing it with the PC-SOLVE II programs on an IBM-PC or compatible microcomputer.

PC-SOLVE II Programs

The PC-SOLVE II system consists of three separate computer programs. The first program (SOLVEA) has been added to the original SOLVE II system to aid the user in entering the study data into a data file. The second program (SOLVEB) and the third program (SOLVEC) are the results of splitting the original SOLVE II program into two parts so that it could be run on microcomputers. All three programs were written using the FORTRAN 77 computer language. However, it is not necessary to have a FORTRAN compiler to use them. They have been compiled and linked to provide executable files ready to run. This compilation was done with the Microsoft Compiler (Version 3.30). Each program is contained on a separate 5.25-inch, double-sided, double-density floppy diskette.

SOLVEA Program

This is an interactive program that asks the user questions and then prompts for the answers. Most of the answers come directly from the SOLVE II data sheets. The questions requiring answers that do not come directly from the data sheets are self-explanatory and will not cause difficulty. The program is set up so that it is not necessary to enter all of the data at one sitting. This eliminates the need for long, tiring sessions at the computer. The program also allows the user to change product prices in an existing mill data file.

SOLVEB Program

This program consists of the first half of the original SOLVE II program. It first provides a listing of the input data file and then processes the data file to provide tables by log grade and diameter class for:

1. Number of logs processed.

2. Lumber tally yields.

---

[1]The computer programs described in this publication are available on request with the understanding that the U.S. Department of Agriculture cannot assure their accuracy, completeness, reliability, or suitability for any other purpose than that reported. The recipient may not assert any proprietary rights thereto nor represent them to anyone as other than Government-produced computer programs.

[2]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

3. Cubic-foot log volumes.
4. Gross log volumes.
5. Net log volumes.
6. Lumber-recovery factor (LRF).
7. Overrun percentages.
8. Lumber grade yield percentages.
9. Actual versus expected lumber grade yields.
10. Nominal lumber thickness yields.
11. Log-size frequency distributions.
12. Green chip yields, in tons per thousand board feet (M bf) (product tally).

While producing these summary tables, the SOLVEB program also generates a second data file to be used by the SOLVEC program.

SOLVEC Program

This program consists of the second half of the original SOLVE II program. It uses the data file produced by the SOLVEB program to provide tables by both diameter and length class for the different log grades found in the study data. Tables are included for:

1. Curved sawing times per log.
2. Curved sawing times per M bf (lumber tally).
3. Curved lumber tally per log.
4. Curved lumber tally per M bf (log scale).
5. Curved lumber value, in dollars per log.
6. Curved lumber value, in dollars per M bf (lumber tally).
7. Chip values, in dollars per log.
8. Chip values, in dollars per M bf (lumber tally).
9. Total product values, in dollars per log.
10. Total product values, in dollars per M bf (lumber tally).
11. Conversion costs, in dollars per log.
12. Conversion costs, in dollars per M bf (lumber tally).
13. Maximum log values, in dollars per M bf (log scale).
14. Zero-profit log values, in dollars per M bf (log scale).

The curved values provided in the first six tables are produced from equations developed by regressions performed during the processing of the data. For each of these regressions, the output includes regression statistics plus graphs showing plots of the data and the resulting curved values.

Using PC-SOLVE II

Following is a discussion of the procedures involved in using the PC-SOLVE II system.

Data Collection

Using the instructions in the original SOLVE II user's manual, the mill data are collected and entered on the SOLVE II data sheets. The original SOLVE II data format should be used in recording the data because the PC-SOLVE II system also uses that format. This will make the task of transferring the data from the data sheets into a computer data file much easier.

Running SOLVEA

First, boot up your PC with your own disk operating system (DOS). For a PC with two disk drives, place the SOLVEA diskette in Drive A (designated drive) and a blank formatted diskette in Drive B. Type SOLVEA and hit the RETURN key to start the program. You will then be asked questions and prompted for answers. Most of these answers will come directly from the SOLVE II data sheets. The requested data are entered below fields indicated by "____ XX.XX". The __ indicates spaces between the data fields.

For a PC with one disk drive, place the SOLVEA diskette in the drive, type SOLVEA, and hit the RETURN key. As soon as the program has been read from the diskette and you have been asked the first question, remove the SOLVEA diskette and place the data diskette in the drive. Then proceed to answer the questions.

For a PC with the SOLVEA program stored on a hard disk, set the hard disk as the designated drive. Then if the data file also is to be placed on the hard disk, type SOLVEA, hit the RETURN key, and proceed to answer the questions. However, if the data file is to be put on a data diskette, place the diskette in the disk drive before typing SOLVEA.

After entering the requested data, you are given a chance to check the information to assure that it is correct and in the right columns. If it is not, enter "E" and hit RETURN. You will be asked to enter the data again. If the information is correct, hit the SPACE BAR and then the RETURN key. You will then be asked the next question. The only time that it is not necessary to hit the SPACE BAR and RETURN key to continue is after you enter the drive designation and name for the data file (in answer to the first two questions).

The steps for entering the SOLVE II data are:

Step 1. The video screen shows:

ENTER DRIVE DESIGNATION FOR DATA DISK—EXAMPLE: B

X

Enter the drive designation for the diskette or hard disk on which the data file is to be stored. The drive designation must be entered even if it is the designated drive.

Step 2. The video screen shows:

ENTER PRIMARY DATA FILE NAME (MUST BE 8 CHARACTERS) EXAMPLE: MIL-LNO22

XXXXXXXX

Enter the name to be assigned to the mill data file. It must have eight characters. A file extension of ".DA1" will be added to the name by the program.

Step 3. The video screen shows:

*THE FOLLOWING COMPONENT NUMBERS (COMP. NO.__) REFER TO THE ONES USED IN THE SOLVE II USER'S MANUAL (USDA FOREST SERVICE GENERAL TECHNICAL REPORT NE-44)

* ENTER 1—TO CREATE A NEW SOLVE DATA FILE

2—TO ADD DATA FOR MORE STUDY LOGS TO AN EXISTING DATA FILE

3—TO CHANGE LUMBER PRICES IN AN EXISTING DATA FILE

X

Enter the code which represents what you want to do.

Step 4. The video screen shows:

SPECIES NAME ?

XXXXXXXXXXXX

Enter the species name of the sawlogs processed during the SOLVE II study.

Step 5. The video screen shows:

SPECIES INITIALS ? (EXAMPLE: YP—FOR YELLOW-POPLAR)

XX

Enter the initials of the species processed during the study.

Step 6. The video screen shows:

COMP. NO. 2—SAWMILL NAME

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

Enter the name of the study mill as entered on Comp. No. 2 of the SOLVE II data sheets.

Step 7. The video screen shows:

COMP. NO. 3—SAWMILL DATA

```
  **DATE**    COST   CHIP    MILL      PM    RM    BF    CD PROD  HOURS   LOG
 MO  DA  YR  /MIN   PRICE   TYPE      %     %     %     %  TIME  /DAY    RULE
_XX__XX__XX__XX.XX__XX.XX___X____  ___XX___XX___XX___XX__XX.XX__XX.XX___X
```

Enter data directly from Comp. No. 3 of the SOLVE II data sheets.

Step 8. The video screen shows:

COMP. NO. 4—SPECIES CONTROL

```
  SPECIES   GRADE  REGR OUT   LGTH   DEG.
            CODE   CODE CODE  CODE   FACT
Y. POPLAR  _____X_____X_____X_____X___XXX
```

Species name will be entered automatically by the program. Enter the other five pieces of information from Comp. No. 4 of the SOLVE II data sheets.

Step 9. The video screen shows:

COMP. NO. 5—LUMBER GRADE TITLES

```
          **************LUMBER GRADE NUMBER **************
    1      2      3      4      5      6      7      8      9      10     11
__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX
```

Enter the abbreviation for lumber grades directly from Comp. No. 5 of the SOLVE II data sheets.

Step 10. The video screen shows:

COMP. NO. 6—LUMBER PRICES

```
SP TH          **********LUMBER GRADE NUMBER **********
          1    2    3    4    5    6    7    8    9    10   11
YP 2____XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX
```

The species initial and lumber thickness are entered automatically by the program. Enter the lumber prices directly from Comp. No. 6 of the SOLVE II data sheets. This will be repeated for each of seven thicknesses.

Step 11. The video screen shows:

COMP. NO. 7—EXPECTED YIELD CODES

```
      ***** LOG GRADE *****
      1      2      3      4      5
_____X_____X_____X_____X_____X
```

Enter the expected yield codes directly from Comp. No. 7 of the SOLVE II data sheets.

Step 12. If expected yields are to be entered as data, the video screen shows:

COMP. NO. 8—EXPECTED LUMBER GRADE TITLES

```
          ••••••••••••••••LUMBER GRADE NUMBER ••••••••••••••••
    1      2      3      4      5      6      7      8      9      10     11
_XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX__XXXX
```

Enter lumber grade abbreviations for expected yields from Comp. No. 8 of the SOLVE II data sheets if expected yields are to be entered as data.

Step 13. If expected yields are to be entered as data, the video screen shows:

COMP. NO. 9—EXPECTED YIELD CONTROL

```
  SPECIES      LOG        LOW       UPPER
               GRADE      DIA.      DIA.
Y. POPLAR   GRADE 1_____XX_____XX
```

The species name and log grade are supplied automatically by the program. Enter the lower diameter limit and the upper diameter limit for the indicated log grade from Comp. No. 9 of the SOLVE II data sheets if expected yields are to be entered as data.

Step 14. If expected yields are to be entered as data, the video screen shows:

COMP. NO. 10—EXPECTED YIELDS

```
  LOGS  DI.     LMBR          •••••••••• LUMBER GRADE YIELDS ••••••••••
                TALLY   1     2     3     4     5     6     7     8     9     10    11
____XXX____8___XXXXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX__XXX
```

The log diameter is provided by the program. The remaining values are entered from the SOLVE II data sheets. This is repeated for each diameter class in the log grade.

Steps 13 and 14 are repeated for each log grade for which expected yields are to be entered as data.

Step 15. The video screen shows:

COMP. NO. 11—CHIP YIELDS

```
C  CHIP    LOW  UP    CHIP    LOW  UP          CHIP   LOW  UP
C  TONS    NUM  NUM   TONS    NUM  NUM * * *   TONS   NUM  NUM
X__XXX.XX__XXX__XXX__XXX.XX__XXX__XXX        XXX.XX__XXX__XXX
```

Enter values directly from the SOLVE II data sheets.

Step 16. The video screen shows:

COMP. NO. 12—SAWLOG DATA

* ENTER LOG DATA BY SAWING ORDER

* SAWING TIMES CAN BE ENTERED NOW OR LATER

* ENTER 9 IN SECOND DATA POSITION AFTER LAST LOG

```
 LOG  SP  LOG      SM     LG LOG    LOG    SPECIES  /
 NUM. ID GRADE     DI.    DI. LGTH  DEF             /
XXXX  YP_____X___XX____XX__XXX___XX  Y. POPLAR  /
                                   /        SAWING     MILL     ORDER
                                   /          TIME     TYPE      NUM.
                                   / _____________XXXX_____1_____    1
```

The species initial, species name, mill type, and order number are furnished by the program. Enter the remaining data directly from Comp. No. 12 of the SOLVE II data sheets. This is repeated for each log in the study.

The log sawing times can be entered at this time or later. This has been done so that the times will not have to be copied onto the log data sheet. They can be entered directly from the sawing-time data sheets in Step 18.

It is not necessary to enter all of the log data at one sitting. The session can be ended at any time by entering "9" for log grade. However, the sawing times and the lumber yields must be entered for all of the logs that already have been entered into the system after entering "9".

If during the entry of the log data a log length less than 8 feet is encountered, you will be asked to check the data. If an error was made in entering the data, you will be asked again to enter the data for the log. If the log length actually was less than 8 feet, you will be told not to use the study log. You will also be told to make sure that the lumber for the log is not entered in Step 19.

Step 17. The video screen shows:

DO YOU WANT TO ENTER SAWING TIMES NOW? (N/Y)

X

If sawing times were not entered with the log data, enter "Y" in response to this question.

Step 18. If "Y" was given to the question in Step 17, the video screen shows:

ENTER SAWING TIMES BY SAWING ORDER:

LOG ORDER = 1 LOG NUM. = 1 ENTER SAWING TIME

XXXX

This will be repeated for each log for which log data have been entered in Step 16.

Step 19. The video screen shows:

COMP. NO. 13—LUMBER YIELD DATA

ENTER LUMBER YIELD DATA FOR EACH LOG BY SAWING ORDER

```
SAWING ORDER NO.     1—ENTER A LUMBER YIELD LINE

                          *******    *******    *******    *******/
LOG  SP    LMBR     GR SURF    GR SURF    GR SURF    GR SURF/
NUM. ID    THCK         MEA        MEA        MEA        MEA/
  1  YP_____X___XX__XXX___XX__XXX___XX__XXX___XX__XXX/
                                              /  *******    *******
                                              /  GR SURF    GR SURF
                                              /       MEA        MEA
                                              /___XX__XXX___XX__XXX
```

For the indicated log number, enter the lumber yields for the first lumber thickness from Comp. No. 13 of the SOLVE II data sheets. You will then be asked if there are yields for another lumber thickness for that log. If you enter "Y", you will be asked to enter the data. If you enter "N", you will be asked to enter the yields for the first lumber thickness of the next log. All of the data will come from Comp. No. 13. The program will continue to ask for this information until all of the lumber yield data have been entered for each log for which log data already have been entered in Step 16.

If the information for all study logs is not entered during one computer session, it can easily be added in later sessions. To enter the additional information, boot up the PC and start the SOLVEA program as discussed earlier. You will be asked to enter the name of the file that the information is to be added to. Next, you will be asked if (1) you want to create a new data file, (2) add to an existing file, or (3) change lumber prices in an existing data file. Your response will be "2". At this point the program will work through Steps 16 through 19 as discussed earlier.

If you want to change lumber prices in an existing data file, boot up the PC and start the SOLVEA program. Enter the file name of the file for which the prices are to be changed. When asked if (1) you want to create a new file, (2) add to an existing file, or (3) change lumber prices, enter "3". At this point the program will work through Step 10.

Whether creating a new file, adding to an existing file, or changing an existing file, the new or modified data file is recorded on the data diskette at the end of the computer session. This file will have the name that you gave in response to the second question asked by the SOLVEA program.

Running SOLVEB

To run the SOLVEB program, you must have a printer hooked to the PC. This does not have to be a 132 column printer. The output will fit on standard 8.5-inch-wide paper. If the PC is not booted up, do so with your own DOS. To run SOLVEB, follow the instructions pertaining to one disk drive, two disk drives, or hard disk discussed under running SOLVEA. When the program starts, it will ask for the drive designation and name of the mill data file. Once this information has been entered, the printer will start printing the data summary tables discussed earlier. While running, the SOLVEB program creates a second data file with the name entered above with an extension ".DA2". This data file will be used by the SOLVEC program.

Running SOLVEC

To run the SOLVEC program, hook a printer to the PC and boot it up with your DOS. Follow the instructions pertaining to one disk drive, two disk drives, or hard disk discussed under running SOLVEA. When the SOLVEC program starts, it will ask four questions: (1) drive designation for data disk; (2) data file name; (3) do you want outlying data thrown out and regressions rerun; and (4) do you want the regression statistics and plots printed. For the initial run on a set of data, I suggest that you answer yes to questions 3 and 4.

By having the outlying data thrown out and having the regression statistics and plots printed out, you can assure that the regression lines more closely fit the data. The output identifies the outlying data by log number. You can then check the data listing to verify that the data are legitimate. If it is legitimate, you can rerun the SOLVEC program by answering no to the question about disregarding the outlyers. At the very least, you should check the plots of the regression lines against the plots of the data.

As the SOLVEC program runs, it prints out the regression statistics if requested and the tables discussed earlier.

Literature Cited

Adams, Edward L.; Dunmire, Daniel E. 1977. **SOLVE II: a technique to improve efficiency and solve problems in hardwood sawmills**. Res. Pap. NE-382. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 19 p.

Adams, Edward L.; Dunmire, Daniel E. 1978. **SOLVE II users manual: a procedural guide for a sawmill analysis**. Gen. Tech. Rep. NE-44. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 18 p.

Adams, Edward L. 1987. **PC-SOLVE II user's manual: a procedural guide for the microcomputer version of SOLVE II sawmill analysis tool**. NE-GTR-116. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 9 p.

A procedural guide for using the PC-SOLVE II system for analyzing hardwood sawmills. PC-SOLVE II is a microcomputer version of the original SOLVE II system. It requires the same input data and provides the same output information. All that is required to use the new system is an IBM-PC or compatible microcomputer that (1) has 512K of resident memory, (2) uses Microsoft disk operating system (MS-DOS) Version 2.0 or greater, (3) has at least one floppy disk drive, and (4) is attached to a printer.

ODC 832.12

Keywords: Computer program; management; operations research