Simultaneous Linear Equations

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MATHEMATICS

MICROCOMPUTER WORKSHOPS COURSEWARE

Simultaneous Linear Equations

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designed by Don Ross

Subject: Mathematics - Algebra Series

Grade Levels: 9 - 12

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MICROCOMPUTER WORKSHOPS
COURSEWARE

Contents

Program Objectives

To give students practice in solving simultaneous linear equations using the method of eliminating a variable by addition or subtraction.

To show the relationship between an algebraic solution and a graphical solution of two linear equations.

Program Description

Simultaneous Linear Equations is designed to help students solve randomly generated simultaneous linear equations of the form **AX + BY = C**, where the values of **A**, **B**, **C**, **X**, and **Y** are integers. All solutions are integers between **−5** and **5** inclusive. Each problem must be solved algebraically for **X** and **Y** using the following rules:

1) Multiply/Divide equation 1 or 2 by a constant
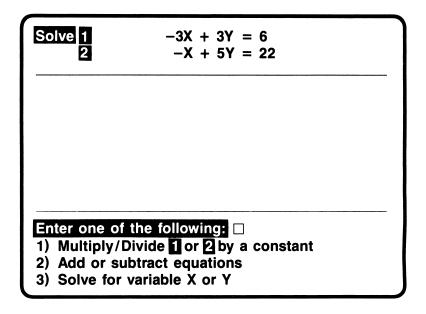**2) Add or subtract equations**
3) Solve for variable X or Y.

Each screen is divided into three parts: equation to be solved, work area, and instruction/message area. The original problem stays at the top of the screen while the student tries to solve the equation, which is constantly updated as progress toward the solution is made.

Program Sequence

There may be minor differences between the *Apple* version of this program, upon which the following summary is based, and versions of the program written for other computers.

After deciding whether to read instructions and to view a sample problem, the student may choose to do one to nine problems. At any point, students making an error will be given a second chance. Students who make a second error will be given the correct answer and an explanation.

A screen similar to the following will appear:

```
┌─────────────────────────────────────────────────┐
│  Solve 1        -3X + 3Y = 6                     │
│        2        -X + 5Y = 22                     │
│  ─────────────────────────────────────────────  │
│                                                   │
│                                                   │
│                                                   │
│                                                   │
│  ─────────────────────────────────────────────  │
│  Enter one of the following: □                   │
│  1) Multiply/Divide 1 or 2 by a constant         │
│  2) Add or subtract equations                     │
│  3) Solve for variable X or Y                     │
└─────────────────────────────────────────────────┘
```

The above problem requires the student to choose item **1**, multiplication or division, because at this point neither addition nor subtraction will eliminate a variable. One variable must be eliminated before it is possible to solve for the other.

The program will respond with:

1) MULTIPLY EQUATION(S) BY A CONSTANT
2) DIVIDE EQUATION(S) BY A CONSTANT
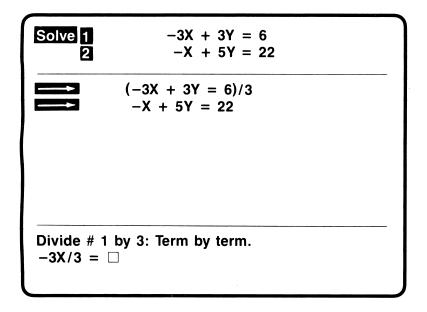
There are a number of paths that can be followed:

1) Multiply equation **#2** by **3** or **−3** (eliminate **X**)
2) Multiply equation **#1** by **5** or **−5** (eliminate **Y**)
2) Multiply equation **#2** by **3** or **−3**
3) Divide equation **#1** by **3** or **−3** (eliminate **X**).

Note: The program allows multiplication of one or both equations only if the result leads to the elimination of one of the variables. Division is allowed only if the resulting equation does not contain fractional coefficients.

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If the student chooses to divide an equation, the program will ask:

DIVIDE EQUATION #1 BY WHAT VALUE?
DIVIDE EQUATION #2 BY WHAT VALUE?

The proper choice is to divide equation **#1** by **3** and leave equation **#2** unchanged.

The screen now looks like this:

```
┌─────────────────────────────────────────┐
│  ┌──────┐┌─┐                             │
│  │Solve ││1│        −3X + 3Y = 6         │
│  └──────┘└─┘                             │
│           ┌─┐                            │
│           │2│        −X + 5Y = 22        │
│           └─┘                            │
│  ──────────────────────────────────────  │
│  ┌────────┐                              │
│  │═══════▶│        (−3X + 3Y = 6)/3      │
│  ├────────┤                              │
│  │═══════▶│        −X + 5Y = 22          │
│  └────────┘                              │
│                                          │
│                                          │
│  ──────────────────────────────────────  │
│  Divide # 1 by 3: Term by term.          │
│  −3X/3 = □                               │
│                                          │
└─────────────────────────────────────────┘
```

Any student who is unable to enter the quotient of **−3X / 3** will be asked to try again. A second error will cause the program to respond with an error message.

After entering the correct response, the student will be prompted to divide the other terms in equation **#1**. The equation then reads **−X + Y = 2**.

Since both equations are now in their simplest form, students can eliminate the **X** variable by subtraction. The student must subtract, because adding will not eliminate the variable **X**.

Note: Subtraction of polynomials is done by negating each term in the subtrahend, then adding the equations.

The student will be prompted to subtract one term at a time:

ADD THE EQUATIONS TERM BY TERM.
−X + X = 0
Y + −5Y = − 4Y
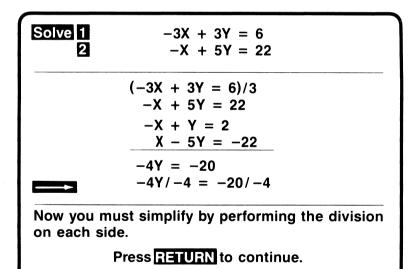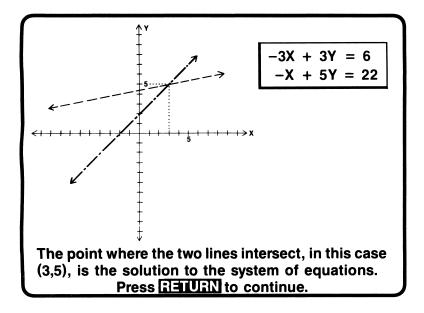**2 + −22 =** − 20

The equation now reads **−4Y = −20**.

Because the variable **X** has been eliminated, the student can now solve for **Y**. Choosing item **3. Solve for variable X or Y**, presents the student with the following menu:

1) ADD SAME VALUE TO BOTH SIDES
2) SUBTRACT SAME VALUE FROM BOTH SIDES
3) MULTIPLY BOTH SIDES BY SAME VALUE
4) DIVIDE BOTH SIDES BY SAME VALUE.

Solving for **Y** can be achieved either by multiplying both sides by **−1/4** or dividing both sides by **−4**. If the student decides to divide both sides by **−4**, that value must be entered. The screen now looks like this:

Solve **1**   **−3X + 3Y = 6**
      2   **−X + 5Y = 22**

(−3X + 3Y = 6)/3
−X + 5Y = 22
−X + Y = 2
X − 5Y = −22

−4Y = −20
−4Y/−4 = −20/−4

Now you must simplify by performing the division on each side.

Press RETURN to continue.

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After completing division on both sides of the equation, the program will respond with **Y = 5**. Now the student may solve for **X** by substituting for **Y** in one of the original equations. All prompts must be answered to arrive at the solution. The program will then check the answers by substituting each solution in both equations and will then show the same solution by graphing both equations:

$$-3X + 3Y = 6$$
$$-X + 5Y = 22$$

**The point where the two lines intersect, in this case (3,5), is the solution to the system of equations.
Press RETURN to continue.**

After each problem is completed, the student will receive an error summary showing errors in the following areas:

- eliminating a variable
- solving linear equations
- computational errors.

A total error analysis will be given at the end of the problem set or when the student decides to quit.

Disk Loading Instructions
Apple **II**, **II+**, //e, //c

1. Remove the disk from its sleeve and place it with the label up and near you into the disk drive. (If you have more than one disk drive, place the disk in drive 1.)

2. Close the door of the disk drive and turn on the computer. Make sure that your TV or monitor is also on.

For the Apple //e and //c computers, the **Caps Lock** key should be depressed.

3. The program should run automatically. If this is not the case, turn off your power switches and check to see that you have connected all your equipment correctly.

*If you have the old Apple **II** with the non-autostart ROM,* you will see an asterisk (*) when you turn on the power switch. Type the number **6**, and then while holding down the key marked **CTRL** press **P**, release both keys, and press the key labeled **RETURN**. The program should now run automatically.

Radio Shack TRS-80 Models III, 4

1. Remove the disk from its sleeve and place it with the label up and facing you in the disk drive.

(If you have more than one disk drive, place the disk in Drive Ø.)

2. Close the door of the disk drive and turn on the computer.

3. The program should run automatically. If this is not the case, check to make sure that your equipment is properly connected and that you have followed the previous instructions correctly.

Commodore 64 (model 1541 disk drive)

Commodore PET (models 4040 or 2031 disk drive)

1. *First*, make sure that all the power switches are turned off. Then, turn on the computer power switch and the switch in the back of the drive. Make sure that your TV or monitor is also on.

2. Remove the disk from its sleeve and place it with the label up and near you into the disk drive. (If you have more than one disk drive, place the disk in drive Ø.) Close the door of the disk drive.

The screen should display the Commodore logo, along with some other information. The final line should read **READY** and there should be a blinking cursor below that. If your computer does not show this, check to make sure your equipment is properly connected and that you have followed the previous instructions correctly.

3. Type **LOAD "*", 8** and press **RETURN**.

The red light on the disk drive should light up and the screen will show the following message:

SEARCHING FOR *
LOADING
READY.

If the computer responds with any other message (such as **DEVICE NOT PRESENT**, or **FILE NOT FOUND**), make sure that all of your components are connected correctly and try again from step 1.

4. Now type **RUN** and press the **RETURN** key to begin the program.

IBM PC, PCjr

Note: The disk(s) contained in this package will run on either a single-sided or double-sided PC disk drive, using either DOS 1.1 or 2.0 or 2.1.

This disk contains an autoboot program. To use it, you must have DOS and BASICA on the program disk. This can be done by using our INSTALL program. Use the following instructions:

1. Users with two disk drives, place the DOS disk in Drive A and the program disk in Drive B and turn on your computer. Users with one disk drive, place the DOS disk in Drive A. *(PCjr users: make sure the BASIC cartridge is plugged into the left cartridge port.)*

2. When the request to enter the date and time appears, press **ENTER** twice.

3. When **A** > appears, type: **B:INSTALL** and press **ENTER**.

Users with one disk drive: every time the computer prompts you for Drive B, insert the program disk. The prompt for Drive A means insert the DOS disk. When the files have been transferred, put the DOS disk away, and boot the program disk.

FOR YOUR INFORMATION
Microcomputer Workshops Courseware uses high quality disks that are verified during reproduction. Occasionally, a few disks will become damaged in transit.

If you think this disk is defective, please try the suggestions listed below.

If these fail, mail the defective disk to us and we will send you a *free* replacement disk immediately.

Disk Hints
* Gently center the disk when you insert it into the drive as some disk drives can not read misaligned disks.

* Turn your computer off for 10 seconds, then back on again.

* Have your drive speed checked: If you are having recurring problems with disks and data, have your repairperson check your drive speed. There are inexpensive programs available that allow you to do your own adjusting.

Disk Care
* Always keep your disk away from magnetic devices such as televisions, monitors, magnets, and motors.

* Store your disk away from extremes of heat and cold.

* Never touch the parts of the disk that show through the sleeve.

* Avoid putting the disk in any location where it might get dusty. Always keep it in the jacket when you're not using it.

* Never write on the disk sleeve with a ball-point pen.

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