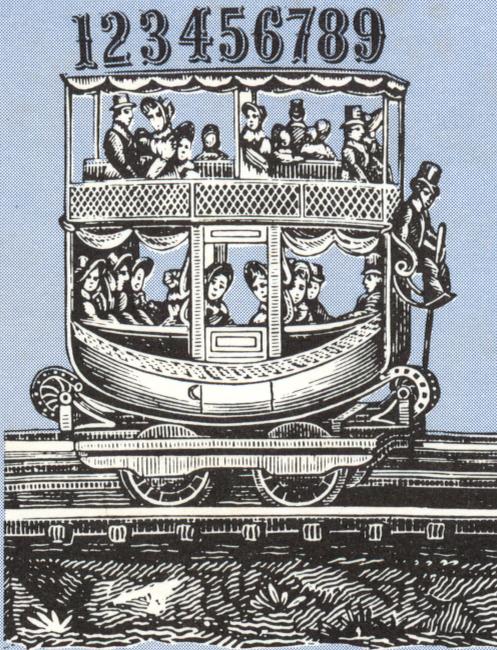


Solving Quadratic Equations



MATHEMATICS



MICROCOMPUTER WORKSHOPS COURSEWARE

Solving Quadratic Equations

Don Ross

Subject: Mathematics - Algebra Series

Grade Levels: 8 - 11

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Program Objectives

To give students practice in solving quadratic equations by factoring.

To show students how to discover the factors of a quadratic expression.

To demonstrate to students how to continue the solution process by setting each factor equal to zero and solving each as a separate equation.

Program Description

Solving Quadratic Equations is designed to help students practice solving step-by-step quadratic equations of the form $\mathbf{AX^2 + BX + C = 0}$, where **A**, **B**, and **C** are integers. All equations are solvable by factoring. A different set of problems appears each time the program is run because coefficients are generated randomly.

Each screen is divided into three parts: equation to be solved, work area, and instruction/message area. Using the screen as a worksheet, the student factors the equation and then sets the factors equal to zero to solve the resulting equations for all values of **X**. An error analysis is provided after each problem and at the end of each set.

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.

To begin, the student has the option to read instructions containing a sample problem, or to go straight to the problems. Then the student must choose between two levels of difficulty: easier and more difficult. At the easier level, the coefficient of the quadratic term is always **1**; at the more difficult level, the quadratic coefficient is either **2** or **3**.

A screen similar to the following will appear:

Problem #1

$$2X^2 - 6X - 20 = 0$$

Work Area:

Enter one of the following (to quit):

- 1) Divide both sides by a number**
- 2) Factor the left side**
- 3) Set each factor = 0 and solve**

Your selection:

1) Divide both sides by a number: The student chooses this option if, as may happen at the more difficult level, **A**, **B**, and **C** have a common factor. After the number to be divided into each term is entered, the equation is simplified to reflect the results of the division. For example, if the original equation is $2X^2 - 6X - 20 = 0$, division of each term by **2** simplifies the problem to $X^2 - 3X - 10 = 0$.

2) Factor the left side: Must be chosen if **A**, **B**, and **C** do not have a common factor, or if the equation has already been simplified. The student is asked to enter the correct factors, one at a time. If the student enters incorrect factors, an error message is printed together with the product of the incorrect factors. Because this product differs from the left side of the equation to be solved, the student can see why the proposed factors are incorrect. The student is then given a second chance. If the correct factors are not forthcoming, the program presents a tutorial which explains in detail how to factor the quadratic expression. (See **Appendix**.) After the correct factors have been entered by the student, the menu reappears.

3) Set each factor equal to zero and solve: Selection of this rule produces a display with a work area showing each factor set equal to zero and an instruction area containing a menu of rules needed to solve the equation. During this final phase, the equation being solved is highlighted.

Problem #1

$$X^2 - 3X - 10 = 0$$

Work Area: $(X - 5)(X + 2) = 0$

$$(X - 5) = 0$$

Enter one of the following (☐ to quit):

- 1) Add same number to both sides**
- 2) Subtract same number from both sides**
- 3) Multiply both sides by same number**
- 4) Divide both sides by same number**

Your selection: ☐

After applying the rules in the proper sequence, the work area will look like the following:

$$\begin{array}{r}
 \text{Work Area: } (X - 5) = 0 \quad (X + 2) = 0 \\
 \quad \quad \quad + 5 \quad + 5 \quad \quad \quad - 2 \quad - 2 \\
 \hline
 X \quad \quad = 5 \quad \quad X \quad \quad = -2
 \end{array}$$

After each problem, the student is given a summary of errors, divided into two categories: **Procedural**, involving incorrect use of a rule, and **Computational**, involving an error in calculation. After completing a set, a total error analysis is given.

Then the student has the option to continue practice with a new problem, review the instructions, or exit the program.

Additional Facts

1. In the easier problems, the range of values for the constant term runs from **-54** to **+54**, while in the more difficult problems, it runs from **-24** to **+24**.
2. After the factors have been set equal to zero, the addition and subtraction axioms can be used interchangeably, as can the multiplication and division axioms. For example, adding **-9** to both sides of an equation is equivalent to subtracting **9**, and multiplying both sides of an equation by **1/2** is equivalent to dividing by **2**.

Appendix

The tutorial takes the student step-by-step through the factoring process, using as an example the expression to be solved. The rate at which the tutorial proceeds is controlled by the **RETURN** key.

First, all factors of the quadratic term and the constant term are listed. Then comes an explanation of how to select the signs to be used in each factor. Next, in a sequence of displays, different possible combinations of factors appear on the screen, together with their products. One such display might look like this:

Problem #1

$$X^2 - 3X - 10 = 0$$

X²		10	
X	X	1	10
		2	5
(X + 1)		(X - 10)	
X ²	- 9X	- 10	

New combinations of factors continue to appear on command until the display shows the factors whose product matches the quadratic expression to be factored. Then, the student is ready to continue with the last step in the solution of the problem.

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.*

Atari 800,1200 one disk drive

1. Turn on your disk drive.
2. Remove the disk from its sleeve and place it with the label up and near you in the disk drive.
3. Make sure that your TV or monitor is also on. Close the door of the disk drive and turn on the computer.
4. The program should run automatically. If this is not the case, check to make sure that your equipment is properly connected and 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.

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 0.)

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.

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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