

**Rational Quadratic Zeros**

In this lesson, you will extend the code from **Integer Quadratic Zeros**. If you didn't complete the activity, complete that activity first or obtain the base code from your teacher.

In this lesson, you will create a game that lets you practice finding x-intercepts for equations in the form  $y = ax^2 + bx + c$ . These solutions will have one rational and one integer solution.

In the challenge, you will apply what you have learned to create a third game. This game will let you practice finding x-intercepts for equations in the form  $y = ax^2 + bx + c$  where both x-intercepts could be rational numbers.

**Objectives:**

**Programming Objectives:**

- Use the input function and a variable to collect and store data from a user
- Use the randint() function to generate random integers.
- Use a while loop to repeat code
- Use if..elif..else statements to make decisions.

**Math Objectives:**

- Explore how x-intercepts are related to factored quadratic equations
- Explore how to factor equation in standard form
- Factor quadratic equations with rational solutions

**Math Course Connections: Algebra 1 or Algebra 2**

In this lesson, you will create a game that lets you practice finding x-intercepts for equations in the form  $y = ax^2 + bx + c$ . These solutions will have one rational and one integer solution.

Example 1:

```

PYTHON SHELL
>>> # Shell Reinitialized
>>> # Running QUADZER2
>>> from QUADZER2 import *
find the x-intercepts
y= 7 x^2+ 36 x+ 32
x1 = |
    
```

```

PYTHON SHELL
>>> # Shell Reinitialized
>>> # Running QUADZER2
>>> from QUADZER2 import *
find the x-intercepts
y= 7 x^2+ 36 x+ 32
x1 = -8/7
x2 = -4
correct!
    
```

Example 2:

```

PYTHON SHELL
>>> # Shell Reinitialized
>>> # Running QUADZER2
>>> from QUADZER2 import *
find the x-intercepts
y= 5 x^2 -17 x+ 6
x1 = |
    
```

```

PYTHON SHELL
>>> # Shell Reinitialized
>>> # Running QUADZER2
>>> from QUADZER2 import *
find the x-intercepts
y= 5 x^2 -17 x+ 6
x1 = 2
x2 = 3
sorry should be 2 / 5 and 3
    
```

**Teacher Tip:**

To complete this project, students will need the base code from Integer Quadratic Zeros.



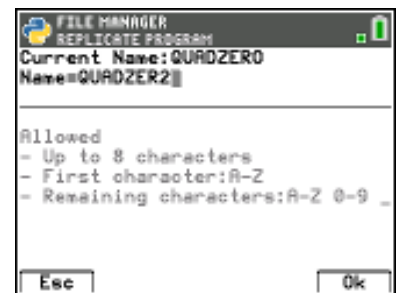
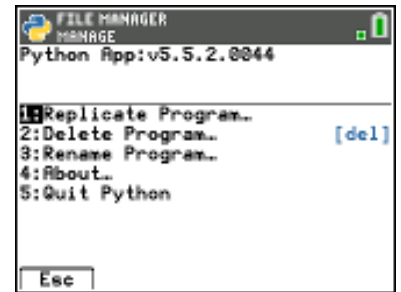
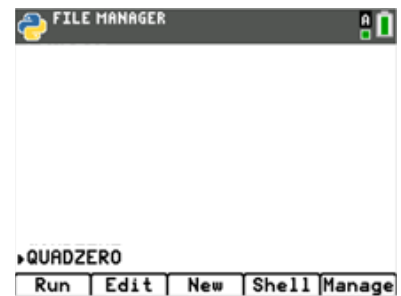
1. Open up the python File Manager.  
[prgm] Python App

Scroll through your list of projects until the arrow is to the left of QUADZERO.

Select [Manage]

Choose: 1 Replicate Program

Name the new program QUADZER2.



2. The factored equations in this problem will be of the type:

$$y = (m \cdot x - x_1)(x - x_2)$$

In the first project, the line

$$x_2 = \text{randint}(-10, 10)$$

creates and stores random integer value from -10 to 10 in the variable x2

Similarly, we will let m be an integer value from two to seven.

Add a line of code after the  $x_2 = \text{randint}(-10, 10)$  to generate and store the value of m.

3. How does the addition of the coefficient m change the values of b and c in the code?

Use distribution to solve and rewrite the equation in standard form.

$$y = (m \cdot x - x_1)(x - x_2)$$

b = \_\_\_\_\_

c = \_\_\_\_\_

Modify the values for b and c in the code if necessary.

4. Does your code match the code to the right?

```

EDITOR: QUADZER2
PROGRAM LINE 0011
# Random Simulation
from random import *

for i in range(5):
    x1=randint(-10,10)
    x2=randint(-10,10)
    m=randint(2,7)

    b=(-x1)+(-x2*m)
    c=x1*x2
    
```

5. When distributing  $m$  in step 3, your final equation started with  $mx^2$  instead of  $x^2$ . How can you modify the print statements to show  $mx^2$  instead of  $x^2$ ? Be careful. You want the value of  $m$  to display not the letter  $m$ .

```

EDITOR: QUADZERO
PROGRAM LINE 0021
print("find the x-intercepts")

if b>=0 and c>=0:
    print("y=x^2+",b,"x+",c)
elif b>=0:
    print("y=x^2+",b,"x",c)
elif c>=0:
    print("y=x^2",b,"x+",c)
else:
    print("y=x^2",b,"x",c)
    
```

Original

```

EDITOR: QUADZERO
PROGRAM LINE 0021
print("find the x-intercepts")

if b>=0 and c>=0:
    pi
elif
    pi
elif
    pi
else
    pi
    
```

Modified

6. How does the user input change?

Let's look at a sample problem:

$$4x^2 + 25x - 21 = 0$$

$$(4x - 3)(x + 7) = 0$$

$$4x - 3 = 0 \quad x + 7 = 0$$

$$x = 3/4 \quad x = -7$$

Not all of the answers will be fractions, but some will be fractions.

The original code:

```
z1 = int(input("x1 = "))
```

will not allow the user to enter the division sign.

To perform a calculation then store as a float, use the `eval()` function.

Modify the two input lines to:

```
z1 = float(eval(input("x1 = "))
z2 = float(eval(input("x2 = "))
```

Fns > Type > Float

Fns > I/O > eval()

```

EDITOR: QUADZER2
PROGRAM LINE 0018
print("y=",m,"x^2+",b,"x",c)
elif c>=0:
    print("y=",m,"x^2",b,"x+",c)
else:
    print("y=",m,"x^2",b,"x",c)

z1=float(eval(input("x1 = ")))
z2=float(eval(input("x2 = ")))
    
```

7. You have one more modification to make. The original project had the line:

```
if (x1 == z1 and x2== z2) or (x1 == z2 and z1== x2):
```

Modify the if statement so it includes the new coefficient m.

*Execute your program. Verify your if statement works.*

8. Did you change the code to:  
if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):

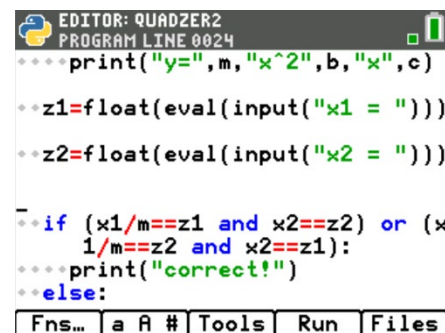
9. Lastly, modify your print statement if the user input is incorrect.

Original:

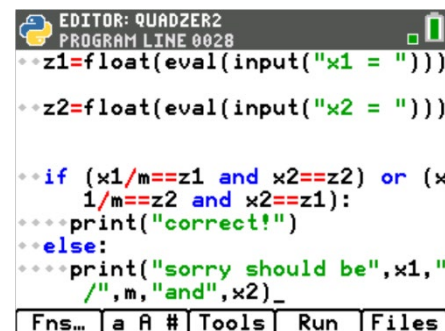
```
print("Sorry sould be",x1,"and",x2)
```

Change To:

```
print("Sorry sould be",x1,"/",m,"and",x2)
```



```
EDITOR: QUADZER2
PROGRAM LINE 0024
print("y=",m,"x^2",b,"x",c)
z1=float(eval(input("x1 = ")))
z2=float(eval(input("x2 = ")))
if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):
    print("correct!")
else:
```



```
EDITOR: QUADZER2
PROGRAM LINE 0028
z1=float(eval(input("x1 = ")))
z2=float(eval(input("x2 = ")))
if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):
    print("correct!")
else:
    print("sorry should be",x1,"/",m,"and",x2)
```

### Teacher Tip:

```
# Random Simulations
from random import *
```

```
for i in range(5):
    x1 = randint(-10,10)
    x2 = randint(-10,10)
    m = randint(2,7)

    b = (-x1) + (-x2*m)
    c = x1 * x2
    print("Find the x-intercepts")
    if b >= 0 and c >= 0:
        print("y=",m,"x^2 +",b,"x +",c)
    elif b >= 0:
        print("y=",m,"x^2 +",b,"x ",c)
    elif c >= 0:
        print("y=",m,"x^2 ",b,"x +",c)
    else:
```

```

print("y=",m,"x^2 ",b,"x ",c)

z1 = float(eval(input("x1 = ")))
z2 = float(eval(input("x2 = ")))

if (x1/m==z1 and x2==z2) or (x1/m==z2 and x2==z1):
    print("Correct!")
else:
    print("Sorry should be",x1,"/",m,"and",x2)

```

**Challenge:**

Create a **QUADZER3** program that generates equations with two fractional x-intercepts.

For example,  $6x^2 - 11x - 35 = 0$  factors to  $(3x + 5)(2x - 7) = 0$ .

The x-intercepts would be  $x = -5/3$  and  $x = 7/2$ .

**Teacher Tip:**

# Random Simulations

```
from random import *
```

```

for i in range(5):
    x1 = randint(-10,10)
    x2 = randint(-10,10)
    m = randint(2,7)
    n = randint(2,7)
    b = (-x1*n) + (-x2*m)
    c = x1 * x2
    print("Find the x-intercepts")
    if b >= 0 and c >= 0:
        print("y=",m*n,"x^2 +",b,"x +",c)
    elif b >= 0:
        print("y=",m*n,"x^2 +",b,"x",c)
    elif c >= 0:
        print("y=",m*n,"x^2",b,"x +",c)
    else:
        print("y=",m*n,"x^2",b,"x",c)

z1 = float(eval(input("x1 = ")))
z2 = float(eval(input("x2 = ")))

if (x1/m == z1 and x2/n== z2) or (x1/m == z2 and z1== x2/n):
    print("Correct!")
else:

```



```
print("Sorry should be",x1,"/",m,"and",x2,"/",n)  
print("")
```