Unit 2: Input, Output and Functions | **Skill Builder 1: A Tale of Two Means**

In this lesson, you will write a program that requires a mathematical function that is not part of Python's "built-in" tools.

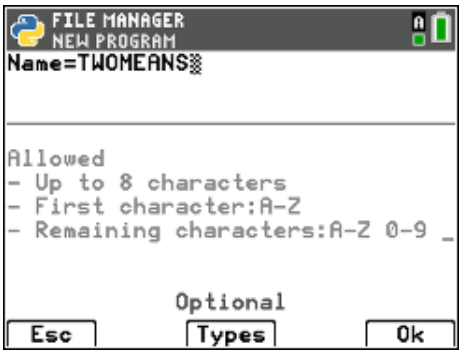
Objectives:

- Use import for additional functions
- Write a program using the menus
- Examine a mathematical relationship

1. The **arithmetic mean** (average, pronounced "arith**METIC**" of two numbers is:

$$am = \frac{a+b}{2}$$

The **geometric** mean is: $gm = \sqrt{a \cdot b}$



Write a program to calculate and display both means to compare them for several examples.

Begin a new Python program and name it **TWOMEANS**.

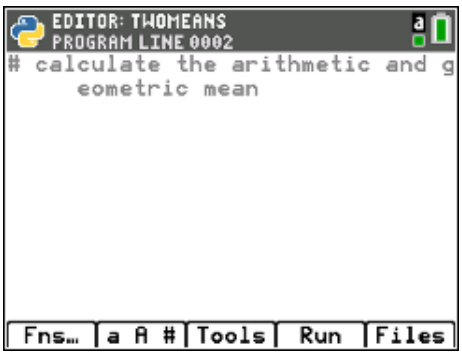
Teacher Tip: Pronunciation matters — arith**metic** (adjective), not **arith**metic (noun).

Example 1: The altitude to the hypotenuse of a right triangle is the geometric mean of the two segments on the hypotenuse.

Example 2: In an arithmetic sequence, each term after the first one is the arithmetic mean of its two neighbors. In a geometric sequence each term after the first one is the geometric mean of its two neighbors.

gm <= am

2. Start a line with the **#** sign ("pound," "number" or "hashtag") found on **<a A #>**. Highlight the symbol, press **[enter]** and select **<Paste>**. This symbol is used for making a **#comment** which is ignored when the program runs. After the **#** sign, write a sentence explaining the purpose of the program. Comments are useful in two ways:

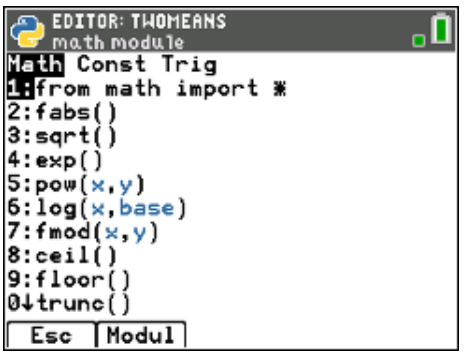


   a. They allow the programmer to document the purpose for different chunks of code. This makes longer programs easier to read and debug if there are errors.

   b. They are useful in debugging because you can "comment out" a line so it does not execute when the code runs. That allows the programmer to systematically isolate where the error occurs.

Note the wraparound feature in the Editor: The remaining part of the line is also indented a bit.

3. This program requires the *square root function* which is *not* part of Python's built-in operations. The square root (**sqrt**) and other mathematics functions are found in the standard Python module called **math**. To use this function, you must import the math module to your code. Select **<Fns…> Modul > math** and select the statement at the top:



from math import *

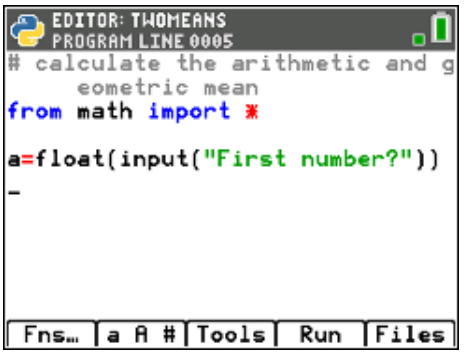
Modules are used to keep Python small and fast: We only *import* stuff that our program will actually use.

The **Math** menu contains lots of mathematics functions and there are separate **Const** and **Trig** sub-menus, too. To use any of these functions the math module must be imported into your program.

*Note: The asterisk (*) means "***from math import** *all."*

Teacher Tip: You can also write **from math import sqrt** if you know you are only going to need the sqrt function. Or **import math** which requires you to write **math.sqrt()**.
The **math** module, along with **random** and **time**, are standard Python modules that are included in the **TI-84 Plus CE Python** system.

4. Use the **input( )** function to enter the first number. First type the variable **a** and the **=** sign (**[sto]** key).



Recall that **input( )** returns a string and we must convert it to a number. Combine those two steps into one by writing:

a = float(input( ))

First, get **float()** from **<Fns…> Type**,

Then, with the cursor inside the parentheses, look on **<Fns…> I/O** for the **input( )** function.

For the prompt inside the **input( )** parentheses, write "First number?"

The question mark is on the **<a A # >** *screen.*

Write a second statement to enter the second number (not shown). This is a good opportunity for you use the **<Tools> Copy Line** and **Paste Line Below** features and then edit the second line.

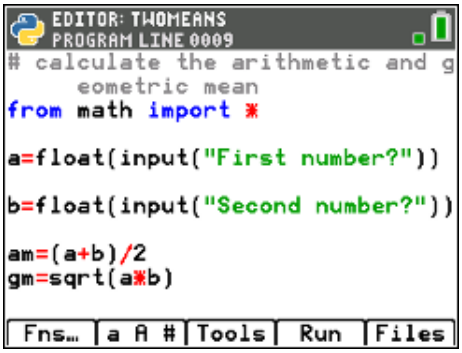
Teacher Tip: Be careful about the two right parentheses at the end of the line: one for **input**() and one for **float**(). This is a perfect example of "composition of functions." The inner function **input** is processed first, and the result (a string) is passed to the outer function **float**.

5. After your two input statements, write two assignment statements, one for the arith**metic** mean and one for the geometric mean:

am = (a + b) / 2
gm = sqrt(a * b)

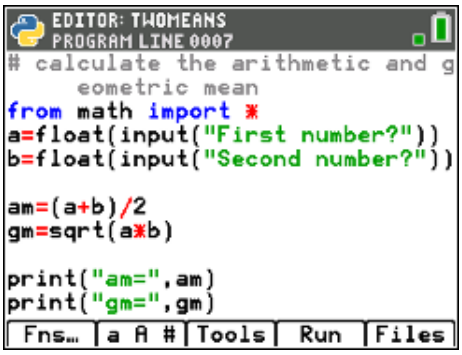
sqrt() is on **<Fns…> Modul math**

You can also simply type **sqrt( )**.



6. The last task is to write the **print( )** statements to display the two calculated values. Use your imagination! A sample is shown here:

print("am = ", am)
print("gm = ", gm)

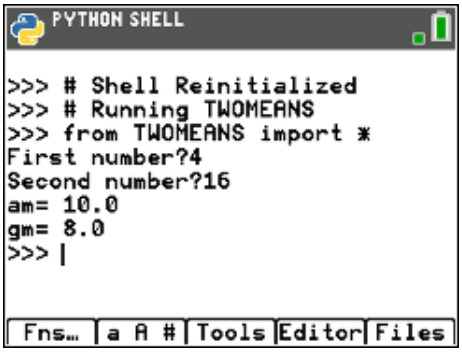


7. Run the program and enter two numbers for which you know the answers… TEST, TEST, TEST.

To rerun the last program, select **<tools>** and press **[enter]**.

After trying many examples, do you notice a relationship between the two means? Is one always larger than the other? Are they ever equal? How are they related to the two numbers you enter? Are there any values which cause an error?

Check your guesses with the teacher! Can you prove it?



Teacher Tip:
am >= gm (When is there equality?)
am and gm are always between a and b.

The **am** formula works for all real numbers (complex, too).
The **gm** formula only works for positive numbers.