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-ins.

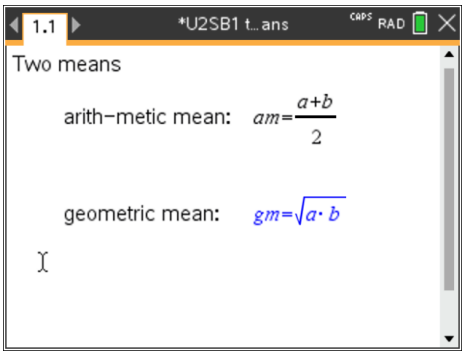
Objectives:

- Use import for additional functions
- Write a program using the menus
- Use multiple units in one problem

The **arithmetic mean** (average, pronounced 'arith**METIC**') of two numbers is:

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

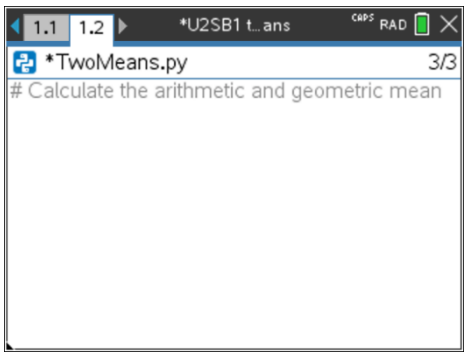
The **geometric** mean is: $gm=\sqrt{a\cdot b}$



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

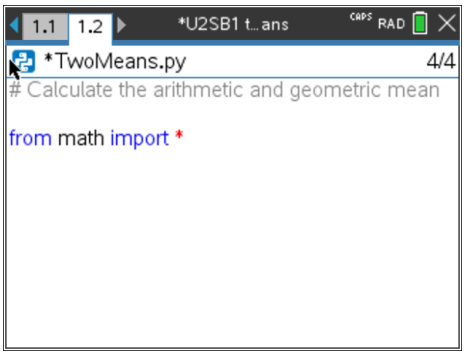
1. Start a line with the **#** sign ('pound', 'number', or 'hashtag') found on the punctuation key. This is used for making a comment which is ignored when the program runs. After the **#** sign write a sentence explaining the purpose of the program. You can also type **ctrl+T** to turn any line into a comment. 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.



2. This program requires the square root function which is *not* part of Python's built-in operations. 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. On **menu > math**, select the statement at the top:

from math import *

The * means import 'everything'.



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-Nspire Python system.

3. Next we use the **input** statement to enter the first number. First type the variable **a** and the **=** sign.

Recall that input returns a string and we must convert it to a number. We'll combine those two steps into one by writing:

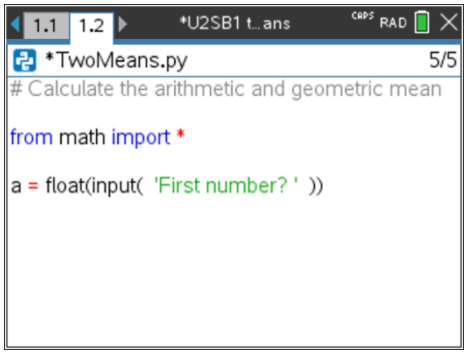
a = float(input( ))

First get **float()** from **menu > Built-ins > Type**,

then look on **menu > Built-ins > I/O** for the **input**() function.

For the prompt inside the parentheses, write 'First number?'

Write a second statement to enter the second number (not shown).

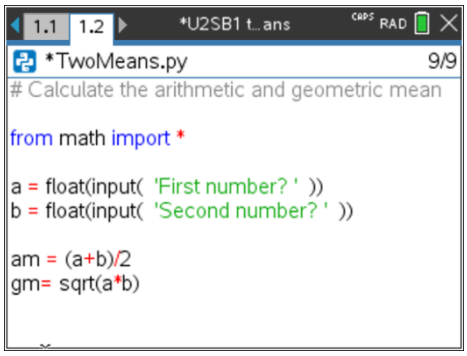


Teacher Tip: Extra spacing in the screenshot is just for ease of reading. It has no effect on the program. Be careful about the two right parentheses at the end of the line: one for **input**() and one for **float**(). Composition of functions!

4. Write two assignment statements, one for the arith**metic** mean and one for the geometric mean:

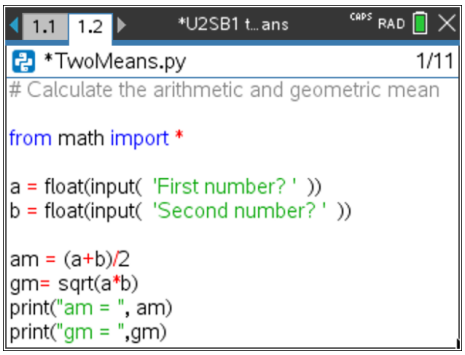
am = (a + b) / 2
gm = sqrt(a * b)

sqrt() is on **menu > math**.

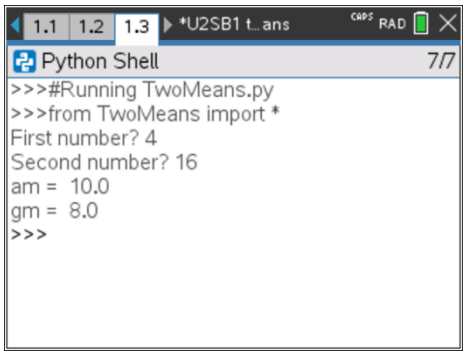


5. The last task is to write the **print()** statements to display the two calculated values. Use your imagination! A sample is shown here:

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



6. Run the program by pressing **ctrl+R** and enter two numbers for which you know the answers…TEST, TEST, TEST.



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.