Shell/Washer Activity

Activity: Your group has three 3D-printed solid objects, each representing the volume of revolution formed by revolving the region bounded by the function $y = 1-(x-2)^2$, $x = 1$, $x = 3$, and the x-axis about the y-axis.

1. Identify each surface in your set of three models. You should have the true solid of revolution (rotated just three-quarters of the way around), and two models that approximate this solid of revolution using shells or washers, respectively. How can you tell the difference between the model that represents the washer method and the model representing the shell method? Hint: Other than their color, what is the same about all washers in the washer model and what is the same about all the shells in the shell method?

2. Using pieces from the second bag, arrange the collection of shells to form an approximation to the volume of revolution.

3. Now use your centimeter ruler to determine the approximate volume of the shells representing the solid. The shells all have the same thickness. (Note that the measurements in centimeters should match the actual units on the graph for the function we are using here.)

   Common thickness of shells (cm): _____

Start on inside →	Shell 1	Shell 2	Shell 3	Shell 4	Shell 5
Largest Diameter (cm):					
Avg. Diameter (cm):					
Avg. Radius (cm):					
Height (cm):					
Show work to compute the volume here:					
Volume of shell:					

Total Volume of Shell Method Solid: _____

4. Now use your centimeter ruler to determine the approximate total volume of the washer method solid. You can use the individual washers for this part. Note that the washers all have the same height/thickness (in the vertical direction).

   Common height/thickness of the washers (cm): _____

Start on bottom →	Washer 1	Washer 2	Washer 3	Washer 4	Washer 5
Large Radius (cm):					
Small Radius (cm):					
Show work to compute the volume here:					
Volume of washer:					

Total Volume of Washer Method Solid: _____

Developed by Paul Seeburger for Taking CalcPlot3D to the Next Dimension, NSF – IUSE #2121152
These materials can be accessed at: https://sites.monroecc.edu/multivariablecalculus/3d-learning-activities/

5. Now show calculus to determine the exact volume of this solid of revolution (using either method and showing all work, including a diagram). The measurements you made above (in centimeters) should match the actual units on the graph of the function we are using. For reference: This solid of revolution is formed by revolving the region bounded by the function $y = 1 - (x-2)^2$, $x = 1$, $x = 3$, and the x-axis about the y-axis.

6. Let's see how the approximations you found in questions 3 and 4 compare with this value.

   a. What is the absolute error of your shell method approximation?

   b. What is the absolute error of your washer method approximation?