Recall. There is a general process for computation using an integral.

1. Pick a slicing strategy. I.e., choose an axis of integration and draw a typical slice.
2. Write a formula for whatever you are measuring on that slice. (This could be area, mass, etc.)
3. Determine bounds of integration.
4. Write an integral for the total amount of whatever you are trying to compute.
5. Compute your integral.

Note. Here are two computation methods that you can use on exams and written homework.

1. Guess an antiderivative. The first month of the course built up skills for this purpose.
2. Use your calculator. How-to videos available here.

There will be specific rules for how you must explain your calculator use. Also, some problems may require that you use the antiderivative method.

Today. Learn two new slicing strategies. Both strategies will be used with density, as in Density. However, today’s problems will expand the notion of density.

1. Density
   - Previous problems used density in the form of mass per unit of area, so that
     \[ \text{total mass} = \text{density} \cdot \text{area} \]
   - Today you will encounter linear mass density, which is mass per unit of length. In this context
     \[ \text{total mass} = (\text{linear density}) \cdot \text{length} \]
   - There will be quantities besides mass. For example, electrical charge per unit of length.
     \[ \text{total charge} = (\text{charge density}) \cdot \text{length} \]
• More generally, in this assignment density can mean any quantity measured per unit of area or length. You can tell what sort of density you have by looking at the “per” units. The general formulas are

\[
\text{stuff} = (\text{stuff per unit area}) \cdot \text{area} \\
\text{stuff} = (\text{stuff per unit length}) \cdot \text{length}
\]

• Finally, today’s assignment includes beams with distributed loads. This is force per unit length, so it works just like linear density.

2. One-dimensional slices

• Use when your data is attached to a one-dimensional object, like a thin rod or a beam.
• There is only one choice for an axis of integration — along the object.
• Slices are tiny bits of the object, with tiny length \( dx \).
• A small amount of stuff is usually

\[
d\text{stuff} = (\text{linear density}) \cdot dx
\]

3. Radial slicing

• Use when your object is two-dimensional (or three) and your data depends on distance from a center point.
• Axis of integration is along a radius extending from the center point.
• Slices are thin rings\(^1\). You will need to know the formula for the area of a thin ring:

\[
dA = 2\pi r \, dr
\]

• A small amount of stuff is usually

\[
d\text{stuff} = (\text{area density}) \cdot 2\pi r \, dr
\]

\(^1\)For now. Later there will be partial rings. And there will also be a three-dimensional version with thin spheres.