
An example of a "ladder" calculation

To give you an idea of the dangers involved in using any sort of "ladder," let's work our way through a simple example. It's difficult to perform astronomical observations during the day, and inside a classroom, so we'll make an analogy: instead of **distances**, we'll measure **volumes** of

- spoon
- cup
- dish
- bucket
- storage container

Your goal is to figure out how many spoons it would take to fill the big storage container. In astronomy, we use a method involving nearby objects to calibrate a second method which applies to distant objects; in this example, we'll use a method involving small objects to calibrate the volume of bigger objects.

You can perform these steps inside the classroom:

1. determine $\mathbf{F_1}$ = number of spoons required to fill a cup. Measure this 3 times, compute mean and uncertainty.

2. determine $\mathbf{F_2}$ = number of cups required to fill a dish. Measure this 3 times, compute mean and uncertainty.

3. determine $\mathbf{F_3}$ = number of dishes required to fill a bucket.

For the final step, please go outside, so that we can use a hose and spill water on the ground. Because the final step involves a difficult measurement with big instruments -- like using the Subaru or Keck telescopes -- you only get 1 attempt per team. You'll have to estimate the uncertainty as you go.

4. determine $\mathbf{F_4}$ = number of buckets required to fill one storage container. Measure this 1 time only, estimate value and uncertainty.

5. using all your values, compute **S** = number of spoons required to fill the storage container. Estimate the uncertainty in this value.

When every team has finished, we'll compare all the values. I wonder if the values will agree with each other ....