
LAB 2

CATAPULT DANGER ZONE

EXPERIMENTAL GOALS

In this lab, you will be ~~playing~~ working with a small-scale modern version of a medieval siege engine technically called a *trebuchet*, which uses a falling weight to launch a small projectile (in this case, a racquetball). Your goals in this lab are to:

1. Estimate the distance that you can be from the front of your trebuchet and still be 97.5% safe (that is, 97.5% of the throws will fall shorter than this distance).
2. Estimate the efficiency of this throwing engine (that is, what fraction of the energy released by the falling weight goes to throwing the ball)?

LABORATORY SKILLS you will be developing

1. You will be developing an experimental procedure for the first time.
2. You will be practicing using the concepts of bell-shaped distributions and 95% confidence ranges that we learned in the last lab session.
3. You will be practicing estimating uncertainties of unrepeatable measurements and *begin* to think about uncertainties in calculated quantities.

SOME PROCEDURAL SUGGESTIONS AND NOTES

Each team will have a meter stick, a stopwatch, a flag, and a trebuchet, and a block of wood and some little rings. The entire class will share a few balances to measure masses and a wheel that one can use to measure larger distances. A good idea might be to mark the position of the trebuchet's front with the block of wood, do a few throws, and mark the approximate place where the ball hits the ground with the flag. On subsequent throws, you can mark the place where the ball falls with the rings, and measure the position of the ring relative to the flag. You can later use the wheel to measure the distance between the trebuchet and the flag with the measuring wheel.

This gives you a basic idea about how to do the lab, but there are many details left to be determined. For example, how are you going to determine the “97.5% safe” distance? Does this depend on the distribution of throw distances being a bell-shaped curve? How are you going to check that? How many throws are you going to do? How are you going to estimate the trebuchet’s efficiency? These are just some of the issues that you have to think about.

Before you start taking any serious measurements, discuss your procedure thoroughly with your teammates and your helper. When you think you have a sound procedure, ask your grader for a procedure interview. Part of your grade for the lab will depend on how well your grader thinks you have designed your procedure.

Your instructor will demonstrate how to cock and fire the trebuchet. **PLEASE NOTE** that the trebuchet arm swings up rapidly and has a really nasty little hook at the end. This hook can, as your mother would say, “poke your eye out.” We are going to ask any person on your team who is operating the trebuchet to wear goggles as eye protection. Even so, please **MAKE SURE** that you release the trebuchet’s arm *only* when you are well out of the way of the swinging arm. You might assign someone to hold the arm down firmly while someone else adjusts the sling. **TAKE SPECIAL CARE TO BE SAFE.** This lab can be a lot of fun, but only if no one gets hurt.