

Surveying a Fixed Route¹

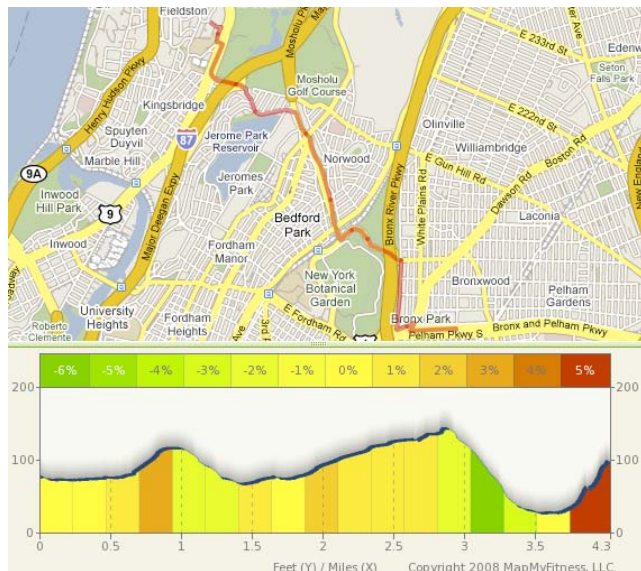
Reid Sherman

Maps and graphs are great tools for conveying information. A whole city's winding streets can be shown on a page, while describing each of their locations and directions would take a book. That city's population every year for the past 100 years could be listed, but it would be boring to read through and hard to interpret, whereas a graph can tell you a fair amount about that city's history in a glance.

Choosing what type of visual representation is the best is tricky, since many times the same information can be shown in many different ways. Certain things one should consider when making a map or graph are:

- What purpose will the map or graph serve?
- Is all the information necessary or is there some that can be left out?
- Is there a particular bit that needs to be emphasized?
- People's eyes tend towards the center of an image and also read from left to right. Can you arrange the information to make sense for someone looking at it that way?

Let's say there's a route between two points that you want to take. You might want a map showing all the turns you have to make and points of interest you will pass. But if you're taking a route that is set out for you, like a road race or a hiking path, then the turns might be less important than other information about the route, especially elevation change. So instead of a map of the area, you might want a graph showing how some variable changes along the route. You see here a map showing a route across the Bronx, but a biker taking that route would also be very interested in the graph below it, showing how the elevation changes with distance from beginning (the point on the lower right) to ending (the point on the upper left). The graph is also color-coded to show the steepness of the slope.



In this lab you'll use some basic surveying techniques and record a short hillside.

Materials:

- Scope level
- Meter stick
- String with meters marked on it, or tape measure
- Plumb line



Scope level

¹ Adapted from "Projections" lab taught at 2007 KICP Yerkes Summer Institute (see <http://kicp.uchicago.edu/education/explorers/2007summer-YERKES/>)

Procedure:

Use these tools to measure the distance and elevation gain for 10 steps along your path:

- 1) Have one person stand a short ways uphill of two partners.
- 2) One downhill person should hold the meter stick to the ground with the plumb line, making sure the meter stick is perfectly vertical (see picture below).
- 3) The other downhill person should look through the scope and direct the uphill person to find a point exactly level with the top of the meter stick.
- 4) Using the string, measure the horizontal distance between the two points.
- 5) You now have horizontal and vertical coordinates for a point. Repeat the process, going farther along your path. If the path switches from going uphill to downhill, be sure to note that the elevation change will be negative, not positive.
- 6) Now plot the points on a line graph. Remember that the elevation gain (or loss) of each step is measured from the previous step, not from the starting point. For example, your first step might go from (0,0) to (8,1) if you went 8 meters horizontally for 1 meter vertical rise. If the next step went 6 meters horizontally for a meter rise, the next point would be at (14,2), because the horizontal and vertical steps would be added to the previous point.



One student adjusts the meter stick to be vertical, while another uses the scope level to spot a point uphill.

Questions:

- 1) Which step on your graph had the steepest rise or decline? What is the angle above horizontal of the path at that point?
- 2) What is the overall angle above horizontal of the path's rise? Take the total rise and the total horizontal distance to find this. Is this the same as the angular slope of the hill?
- 3) What information is missing from your graph?
- 4) What are the major sources of uncertainty/error in your graph?