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F/K Data Visualization Lab 1

1) # THE MODEL

This model is an attempt to calculate the area of a pre-defined space within Earlham College's campus. This space in question is a series of connected walkways that form a quadrilateral that has a shape similar to that of a rectangle, but does not have the same dimensions. The purpose of this model is to juxtapose data and calculations derived from four different methods of measuring distances and area to of this space to illustrate variances in reliability and accuracy of each tool.

2) To build this model I chose the following four tools to collect data and determine the area of the space:

   a. No-Technology –at-all device
   b. Global Positioning System (GPS)
   c. Google Earth
   d. Measuring Wheel (Large)

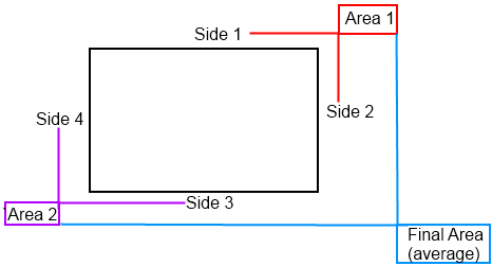
   Each method/tool was used to collect 3 readings respectively which were then averaged to provide a more accurate representation of the calculation of the area. During each of the 3 readings a slight variation in the approach of measuring the data was introduced, not radical enough however, to skew the data in anyway. The final averages as well as the averages for each tool are visualized using___.

3) # TOOLS/METHODS

A) **No-Technology-at-all device**

Each of the walkways in this rectangular area were made up of concrete squares, however two of the corners or vertices were bigger polygonal shapes. There were 3 different types of squares of slightly different sizes, but which were approximately the same dimensions. Thus for the sake of simplicity I assumed that the walkways were only made up of squares and that they were all the same size. In this method I calculated the length of a side of a square (*which was $4^{1}/_{2}$ feet*) and counted the number of squares along each side of the rectangle and then used that to determine the area. To provide as accurate a calculation as possible in relation to

the assumptions my model makes, I calculated the area for each of the 3 readings by multiplying *Side 1* & *Side 2* to calculate one area, then multiplied *Side3* & *Side 4* to calculate another area, and then took the average of those two calculations to determine the final area for that reading.



B) **Global Positioning System (GPS)**

GPS is a navigational system using satellite signals to fix the location of a radio receiver on or above the Earth's surface (http://www.merriam-webster.com). In this method I stood at each corner of the rectangular area and used a GPS receiver to demark the location in terms of latitude and longitude (N,W). For each of the 3 readings I stood in the center of the square at each corner of the rectangle and restarted the device before I took a new reading. Then I used the formula for calculating the *Area of Irregular Polygons* [***A = (1/2)(x1*y2 - x2*y1 + x2*y3 - x3*y2 + x3y4 - x4y3 + x4*y5 -x5*y4 + x5*y1 - x1*y5)***] , to determine the area.

C) **Google Earth**

Google Earth is a virtual globe, map and geographical information program. (http://en.wikipedia.org/wiki/Google_Earth) In this method I took the GPS coordinates from the previous method and used Google Earth's Polygon tools to measure the area of the rectangular space.

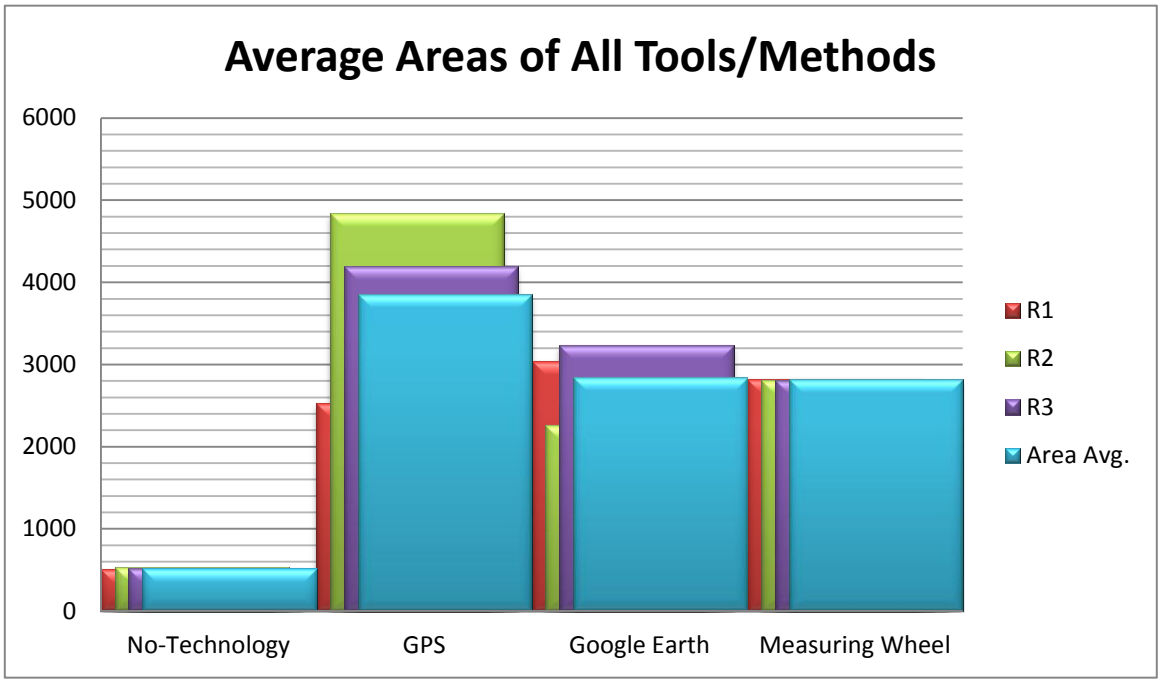
D) **Measuring Wheel** (Large)

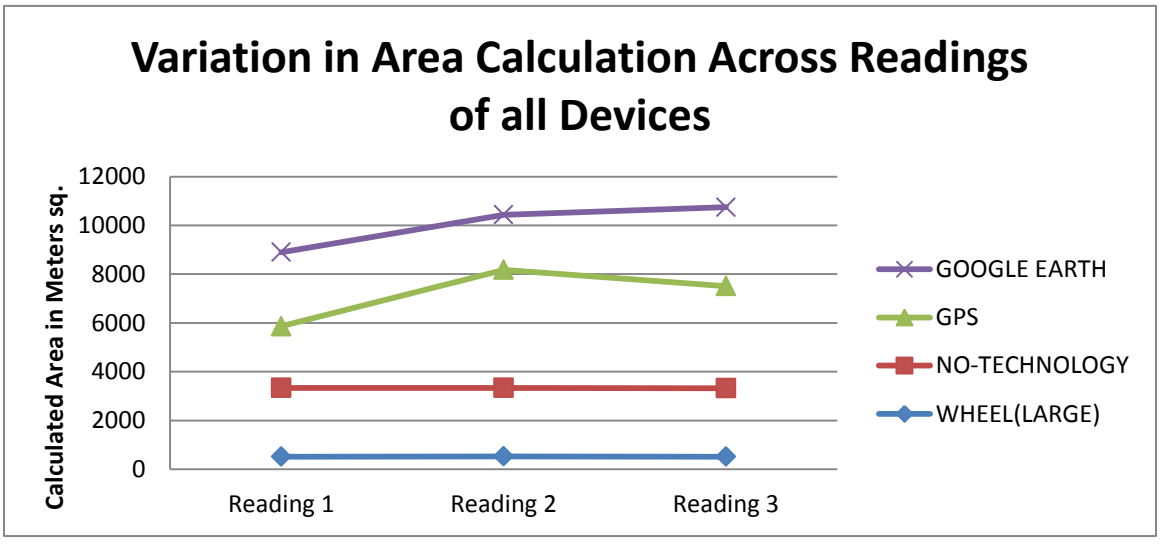
The Measuring Wheel is a device for measuring distance marked in fractional increments of revolution from a reference position, and its current position can be represented as fraction of a revolution from that position.(http://en.wikipedia.org/wiki/Surveyor's_wheel) The measuring wheel I used measures the distance in feet In this method I walked along the edge of each walkway that makes up the rectangular space. For each reading I noted the length of each side and similar to the No-Technology-at-all method, I multiplied *Side 1* & *Side 2* to calculate one area, then multiplied *Side3* & *Side 4* to calculate another area, and then took the average of those two numbers to determine the final area.

4) ASSUMPTIONS

My model makes the following assumptions:

i. The quadrilateral being measured is a rectangle.
ii. Each of the squares making up the walkways of the quadrilateral are the same size.
iii. The walkways are made up of **only** squares.





AREA (GPS Coordinates with Irregular Polygon Formula)	AVERAGE

Reading 1	*Reading 2*	*Reading 3*	
2,528.1 m^2	4,841.1 m^2	4,189.4 m^2	3852.9 m^2

AREA (No-technology-at-all Method)			**AVERAGE**
Reading 1	*Reading 2*	*Reading 3*	
511.5 m^2	526.3 m^2	516.6m^2	518.1 m^2

AREA (Google earth Calculation)			**AVERAGE**
Reading 1	*Reading 2*	*Reading 3*	
3043.7 m^2	2,263.7 m^2	3,231.8 m^2	2,846.4 m^2

AREA (Measuring Wheel)			**AVERAGE**
Reading 1	*Reading 2*	*Reading 3*	
2, 822 m^2	2, 810 m^2	2,807 m^2	2813 m^2

5) <u>SOURCES OF ERROR</u>

a. **No-technology-at-all Method**
   i. Deterioration of the walkways.

b. **GPS**

i. Miniscule variations in last 2 digits of decimal coordinates due to even very slight movement.
ii. Coordinates are usually of by approximately 20 meters.

c. **Google Earth**
    i. Possible small errors when using the polygon tool to demark the area.

d. **Measuring Wheel (Large)**
    i. Debris along the walkways.
    ii. The wheel can slightly rock side to side while rolling.