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Lab 1: MEASURING THE REAL WORLD

Introduction

In this report, I will be analyzing how different measuring tools are used to determine the length of given distance. I will further use the acquired information to calculate the area of the enclosed region. And by calculating the absolute and relative errors, I will be able to establish which instrument gives more precise or accurate readings. The accuracy and precision of the results obtained for each instrument will depend on how effectively and properly each tool is used.

The results produced in this lab will be calculated under the following assumptions:

1. The enclosed region is a perfect rectangle that is to say it's a plane four-sided figure with each two edges forming 90^0 between them and that two opposite sides were equal to each other. Therefore in calculating the area I used the formula (length x width)
2. The region is on a complete flat land
3. In using the non-technology technique, I assumed that each stride I made was of the same length.

I will be using two different sized measuring wheels, a tape measure and a non-technology technique. In order to ensure precision and accuracy of each instrument, I obtained several length and width readings with each of them

Procedure

1. ***None technology technique (using strides)***

   In this procedure, 'no technology' was used. I measured the length of my stride. I walked along the length of the region counting how many strides I could make from one end to the other. During this procedure, I tried to make the strides to be of equal length (assumption). I repeated this step two more times in order to increase my precision. I repeated this process for the width

2. ***Measuring wheels (small & big)***

   With the bounds of the specific region determined and the measuring scale on the small wheel set to zero, the wheel was rolled along the length of the region. In order to produce more accurate values, the movement with the wheel was limited to a straight line. This step was repeated for the width and several other times in order to increase precision.

   This procedure was repeated for the large wheel

3. ***Tape measure***

In this procedure, I laid the tape measure along the length of this region and determined its length. I did the same for the width. I repeated this process 2 other times. In using the tape measure, I ensured that it was laid down straight in order to get more accurate values

Data and analysis

In calculating the area of this region, I converted each of the lengths and width into the SI units (meters). I then calculated the average of each. With the average, I was not only able to calculate the area of the region but also determine the absolute and relative errors of the area obtained.

Conversions used in the calculations

1ft = 0.3048m

I stride = 0.703m

Table 1 – table showing the analyzed raw data

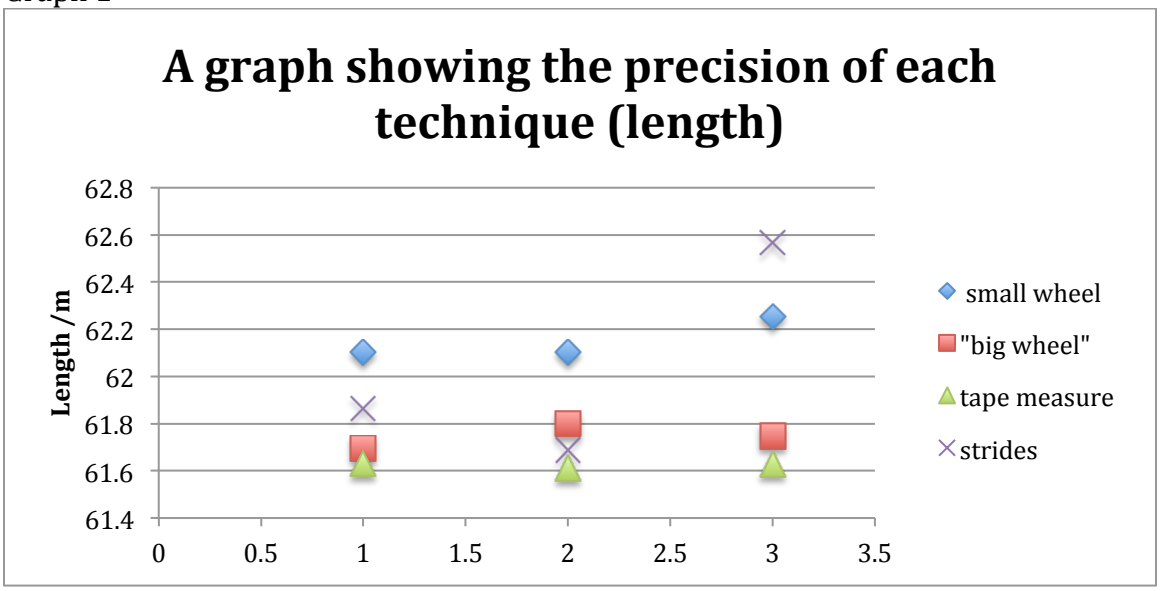
SMALL WHEEL	length (ft)	length /m	absolute error	width (ft)	width(m)	absolute error		
	203.75	62.103	0.0508	151.8333333	46.2788	0.008466667		
	203.75	62.103	0.0508	151.8333333	46.2788	0.008466667		
	204.25	62.2554	0.1016	151.9166667	46.3042	0.016933333	AREA (m^2)	absolute error
average		62.1538	0.067733333		46.28726667	0.011288889	**2876.92951**	3.212745047
relative error		0.00108977			0.000243888		0.00111673	

BIG WHEEL	length (ft)	length (m)	absolute error	width (ft)	width(m)	absolute error		
	202.41667	61.6966	0.0508	150.6666667	45.9232	0.059266667		
	202.75	61.7982	0.0508	151	46.0248	0.042333333		
	202.58333	61.7474	7.10543E-15	150.9166667	45.9994	0.016933333	AREA (m^2)	absolute error
average		61.7474	0.033866667		45.98246667	0.039511111	**2839.29776**	2.894352395
relative error		0.000548471			0.000859265		0.00101939	

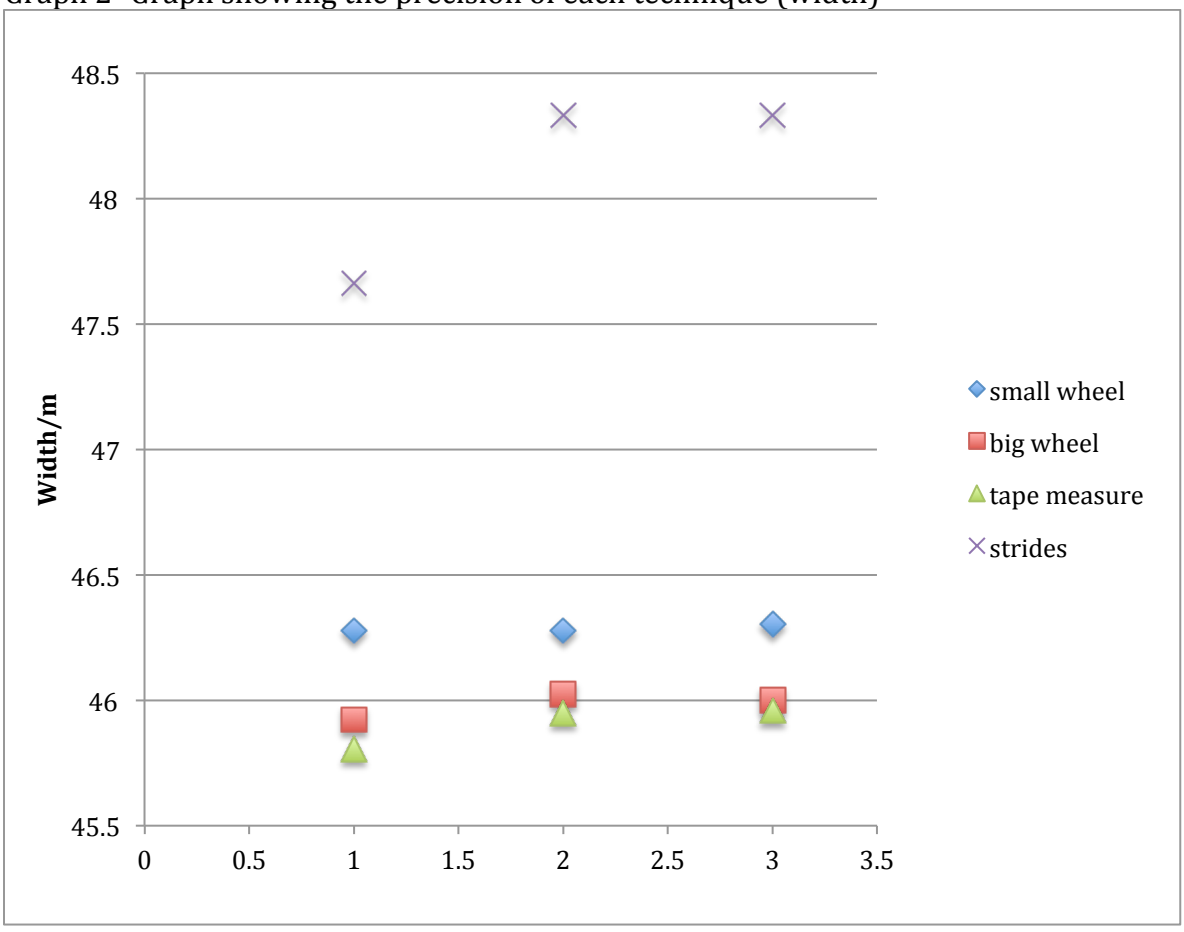
TAPE MEASURE	length (ft)	length (m)	absolute error	width (ft)	width(m)	absolute error		
	202.2	61.63056	0.007112	150.28	45.805344	0.098552		
	202.14	61.612272	0.011176	150.75	45.9486	0.044704		
	202.19	61.627512	0.004064	150.78	45.957744	0.053848	AREA (m^2)	absolute error
average		61.623448	0.007450667		45.903896	0.065701333	**2828.75635**	4.063162739
relative error		0.000120906			0.00143128		0.00143638	

	I stride	0.703	m					
STRIDES	ngths (stride	length (m)	absolute error	width(strides)	width(m)	absolute error		
	88	61.864	0.17575	67.8	47.6634	0.445233333		
	87.75	61.68825	0.3515	68.75	48.33125	0.222616667		
	89	62.567	0.52725	68.75	48.33125	0.222616667	AREA (m^2)	absolute error
average		62.03975	0.3515		48.10863333	0.296822222	**2984.64758**	25.00116669
relative error		0.005665722			0.006169833		0.00837659	

Graph 1

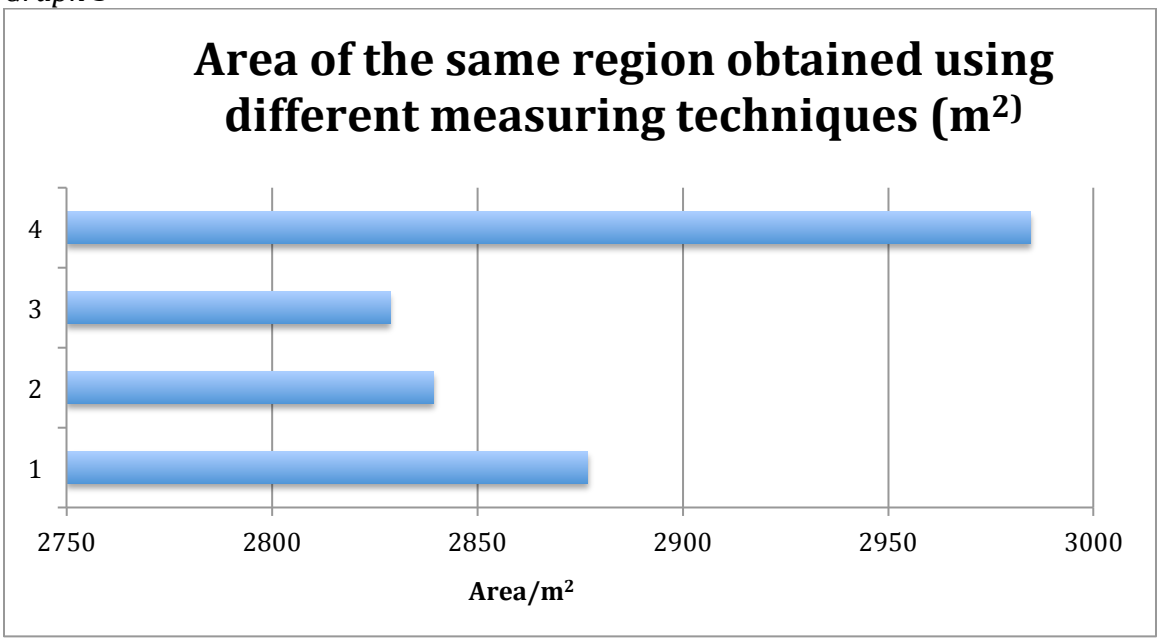


Graph 2- Graph showing the precision of each technique (width)



Note: in graph 1 and 2, the horizontal scale is to create the space in the different measurements

Graph 3



Key
1-small measuring wheel
2- big measuring wheel
3-tape measure
4-strides

In calculating the absolute error of each value, I took the absolute difference between x_1 and μ where x_1 is any value and μ is the average value of x_n in the same category.

Using values from the small wheels:

Absolute error = abs (62.103-62.1538) = 0.0508

Therefore the relative error of the length = absolute error/value obtained

Relative error = (0.06773/62.1238)

= 0.0010898

From the data obtained, I can't give you the exact area of the measured region since considering all the four gives a wide range of the area (from graph 3). This range makes me question the accuracy of the values acquired. All I can do I

determine which instrument produces the most precise results and work with it to get better results.

From the graphs 1 and 2, I am able to tell what the most precise instrument(s) is/are and how precise it is. Both measuring wheels and the tape measure produce more precise results than the strides techniques. This can also be seen/told from the high relative error values

The wide range in the area implies that there were random and systematic errors involved the techniques used. Below are some of them:

1. While using the measuring wheel, it was hard to ensure that the wheel rolled along a straight path. It is important to avoid wiggling and zig-zag movements of the wheel because these increase the would-be distance of any particular length
2. One possible source of error in the high value in absolute error from using stride is from the assumption I made that all the strides where of equal length. The possibility of this occurring is 1) if I were perfect controlled robot or 2) if I modified the procedure for example if I measured the length of my stride and getting a string of the same length, I move it along the length of the region and by multiplying how many times I moved it along by the length of my stride, I would get more precise if not accurate results.
3. Another possible source of error could have been obtained from or carried on along the calculations. With all the conversions and rounding off (up or down) done at every step, this could have increased or decreased the final area of the region. For example the conversion

4. Assuming that this enclosed region was a perfect rectangle would have resulted in less accurate areas of the region.
5. The inconsistent results obtained could be attributed to handling tools that I was unfamiliar with. Practice makes perfect therefore sing a tool for the first time especially to produce actual usable results usually causes glitches in the final results.

Conclusion

From this lab, I can conclude that the use of technology increases the possibility of obtaining more precise if not accurate results than using a non-technology method.