[SAMPLE LAB REPORT]

Mr. Kulik
8/30/07
Lab Partner:
Cornelius

Finding the Value of Pi

Purpose: To experimentally find the value of pi by
1) comparing the mean circumference and mean diameter measurements of various circles
2) analyzing a graph of circumference vs. diameter

Background:
- pi (π) represents a ratio of the circumference of a circle to the radius of the circle and has an accepted value of approximately 3.1416
- the relationship between Circumference (C) and diameter (d) can be written as $C = \pi d$

Materials: meter stick, ruler, string, scissors, various circular objects

Procedure:
1) Measure and record the diameter and circumference of various circular objects around the room. For circumference measurements, measure the length of a piece of string after wrapping it one full turn around the outside of the circles.

Data and Analysis:

Table 1: Diameter and circumference measurements of various circles

	diameter, d (cm)	circumference, C (cm)
circle 1	5.35	16.95
circle 2	12.70	40.80
circle 3	8.95	28.95
circle 4	7.65	24.05
circle 5	14.30	44.20
circle 6	3.25	10.25
circle 7	19.00	60.65

Table 2: Calculated Values

mean circumference, C (cm)	32.26
mean diameter, d (cm)	10.17
pi, π	3.172

Sample calculations:

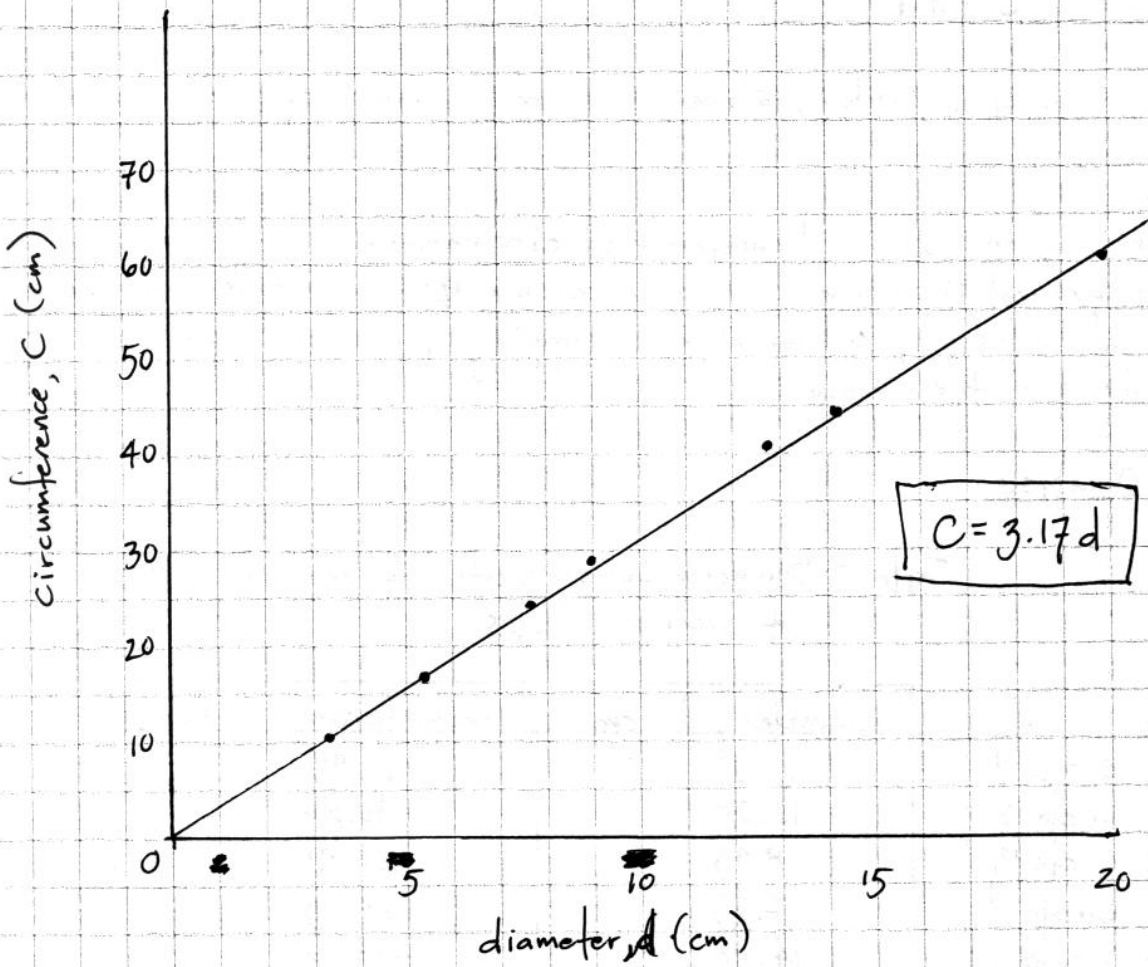
pi: $C = \pi d$

$\pi = \frac{C}{d}$

$\pi = \frac{32.26\text{cm}}{10.17\text{cm}}$

$\pi = 3.172$

Circumference vs. Diameter for Various Circles



slope of best-fit line: $\text{slope} = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{16.95\text{cm} - 0\text{cm}}{5.35\text{cm} - 0\text{cm}}$

using points (0,0) and (5.35, 16.95)

slope = 3.17

Error analysis:

$$\text{percent error} = \frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100$$

$$\text{percent error} = \frac{|3.1416 - 3.17|}{3.1416} \times 100$$

$$\text{percent error} = 0.904\ \%$$

Conclusion:

The value of pi was experimentally found by comparing the circumferences of various circles to their diameters. Regardless of the size of the circle, a relatively consistent ratio of approximately 3.17 was observed between the circumference and the diameter. This result was consistent for both methods of analysis – calculating pi using the mean values of circumference and diameter and calculating pi from the slope of the best-fit line in the circumference vs. diameter graph. With only a 0.904% error for the experimental value, the objectives of this lab experiment were successfully met.

Although the difference between the experimental value and the accepted value of pi in this lab was minimal, there were a few possible sources of error. First, there may have been some error in the measurement of the diameters since these measurements were based on the experimenter's best judgement of the center line locations. Misjudgement in either direction from the center line would have resulted in a slightly smaller value for the diameter, causing the experimental value of pi to be larger than it should have been. One way of reducing this error would be to measure the diameter with calipers so that the measurement is truly across the widest part of the circle. Secondly, there may have been error in the circumference measurements because of slight stretching in the string as it was wrapped around the circles. This too would have caused the experimental pi to be larger than normal. A less stretchable cord could be used in place of the string to reduce this error. Also, slight inaccuracies may have been introduced when marking the ends of the string. Marking the ends of the string a bit too wide or a bit too narrow would have caused pi to be a bit larger or a bit smaller, respectively. Furthermore, the value of pi determined from the graph depended on the experimenter's judgement of the best-fit line. Too steep of a line would have made pi larger; too shallow of a line would have made pi smaller. Using a computer program to find the best-fit line would be more accurate.

To improve this experiment, the error reduction methods described above could be used in the future. Suggestions for further investigation would be

to conduct a 2-dimensional experiment where the area of a circle is compared to its radius squared and a 3-dimensional experiment where the volume of a sphere is compared to 4/3 of its radius cubed.