

LABORATORY I

BAE 5413

SPRING 2007

TITLE: Budgeting uncertainty

OBJECTIVE:

To compare uncertainty budgets for two measurements of length. A statistical method and a direct method will be used to measure the average diameter of a circle.

PROCEDURE:

Use copies of the circle sets on the following page. Place the circled paper on the floor, face down over a sheet of carbon paper. Working in pairs drop marbles or ball bearings from head height so that they hit the paper. The sphere must be caught after the first bounce. Repeat this at least 100 times. You should take care to distribute the hits as randomly as possible over the entire target area. It is "OK" to miss the square on the paper from time to time. Those points will naturally be excluded from the data set. (Note the paper is 21.5 cm by 28.0 cm.)

Count the total number of dots within the square on the paper (total hits), as well as the number of dots just completely within a circle (circle hits). Determine the total area of the square on the paper, and count the total number of circles on the paper. If the circles are of uniform size and the hits are randomly distributed, then one might assume:

$$(\text{circle hits})/(\text{hits}) = (\text{area of all circles})/(\text{rectangular area})$$

Therefore, you might calculate the total area of all circles. From this you might calculate:

$$\text{area of one circle} = (\text{area of all the circles})/(\text{number of circles})$$

The area of one circle can be used to calculate the radius of a circle (area = $\pi \cdot \text{diameter} \cdot \text{diameter}$). This calculated diameter may then be compared with a direct radius measurement.

Determine the diameter of one circle as many times as you think is appropriate using a linear rule.

Compose an uncertainty budget for both types of measurements. Use the table in Fraden as an example error budget.

REPORT:

Briefly report the above work. Include a short introduction describing the purpose of the work. Include this handout as a description of procedures and add a discussion of additional procedures (if any). Report the results of the measurements and the error budgets for both measurements. Compare the relative uncertainty of both of the measurements. Include an abstract on the front page of the report that includes a title, your name. The abstract should encapsulate the critical results of the study.

