THE DOT PLANIMETER, A NEW WAY TO MEASURE MAP AREA

Walter F. Wood
State University of Iowa

A review of the geographic literature produced during the present century reveals a trend in the direction of more quantification of findings. Researchers, however, are sometimes frustrated in attempts to be quantitative because they do not have a really good method to measure areas represented on maps. This, fortunately, need no longer be true.

Most of us have, at times, made use of one of the many types of mechanical planimeters. A short time spent with the use of one of these instruments quickly reveals many of its shortcomings. First, the planimeter must be taken out of its box and assembled. Many models require the making of precise adjustments and the prior measurement of areas of known size to check the adjustment. When the planimeter is assembled and adjusted the operator is ready to measure the area represented on a map. He traces the boundary of the area with a pointer and in so doing causes a little wheel touching the map surface to turn as it moves in sympathy with the pointer. The wheel in turn activates a mechanism which is connected to a dial which records the area traced. This reading will be accurate if the operator has a very steady hand and traces the boundary with utmost care, and if the surface of the map is neither too smooth nor too rough, and if the area being measured is conveniently located far enough from the edge of the map to allow the little wheel to trace its course without running off the edge. There are other "ifs", but these are the most common.

Many researchers, either because of the prohibitive cost, or because of the inadequacies of the mechanical planimeter have tried other methods. The most common of these is the counting of squares. A grid constructed on transparent material is laid over the area being measured, and the small rectangles of known size lying entirely within the boundary are counted. Added to this number is the number of whole squares estimated to be equal in area to that of the partial squares also included within the boundary. The sum thus obtained is then converted to the desired unit of earth measure, such as acres or square miles. One can achieve a good measure of accuracy with this method, especially if he uses a relatively fine grid. Experience shows, though, that this method, too, has its drawbacks. Often operators are surprised to find that they get quite widely divergent area readings for areas known to be equal to each other but different in shape. Also the same area measured on successive days by the same operator may appear to have either grown or shrunk in the meantime. Some of the accuracy of this method is dependent on the ability of the operator to make subjective estimates of the areas of partial squares. Perfection in estimating areas in this way is not possible because individuals do not always feel the same, and feelings are responsible, in part, for errors in subjective judgment.

What is clearly needed is a device which will overcome both the mechanically originated shortcomings of the mechanical planimeter and the psychological ones of the square counting method. This is accomplished by the dot planimeter. The principle underlying this device is both new and simple, and may be briefly stated thus: "The number of evenly spaced dots falling within a boundary is proportional to the area enclosed." The method employing this principle is best understood in terms of the device which uses it (Fig.1).

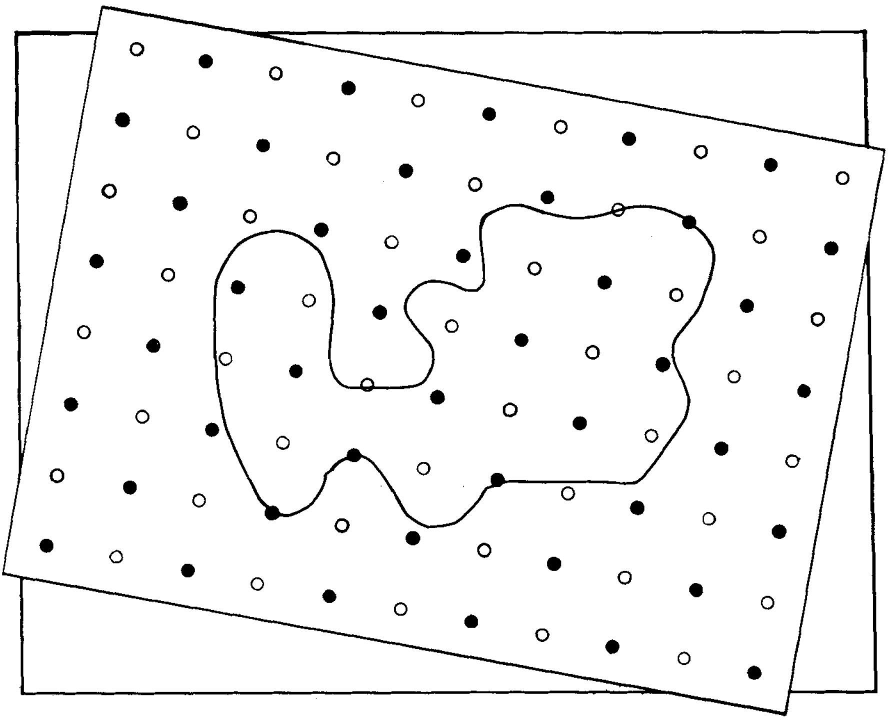

Fig. 1. A type symbol •, B type symbol o

Equally spaced dots of two different types are arranged alternately into horizontal and vertical rows on a piece of transparent material. This, in its simplest form, is a dot planimeter. In order to measure an area, all the operator need do is place the dot planimeter over the area to be measured and count the number of dots falling within the boundary. If a symbol of type A touches the boundary it is included in the count, but B type symbols are not counted. In Figure 1, twenty-one dots are in a position to be counted. The value of each dot is equal to the square of the space between them. Thus, if the dots are assumed to be an inch apart the measured map area may be said to contain twenty-one square inches. If the dots are spaced one half inch apart the measured area will be indicated as 5.25 square inches, and so on. A high degree of accuracy may be achieved by averaging several counts obtained from a coarse grid or a few counts from a finer grid. The resulting average may then be converted to units of earth surface measure.

The following are a few time-saving techniques which may be used where applicable:

1. More advanced models place the dots into groups of tens and hundreds for ease in counting.

2. Vertical and horizontal scales aid in mentally constructing a large rectangle containing a known number of dots with which to start the count.

3. A grease pencil may be used to check off the dots and groups of dots as they are counted.

4. Tables showing the maximum and average errors to be expected under all conditions are used as an aid in choosing an optimum spacing of dots.

This device makes the measurement of mapped areas practically as easy as the measuring of distance between two points on a map. Those who have used the dot planimeter experimentally under my direction agree that it is practically fool proof and gives better results than any other method. If anyone can see well enough to distinguish one type of dot from another and is able to count, success is assured.