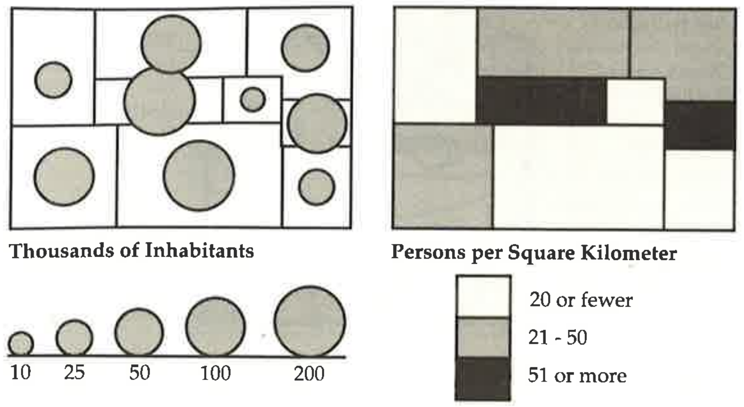

FIGURE 2.13. Graduated point symbols (left) and graytone area symbols (right) offer straightforward portrayals of population size and population density.

[illegible]

Area symbols are not the only ones useful for portraying numerical data for states, counties, and other areal units. If the map must emphasize magnitudes such as the number of inhabitants rather than intensities such as the number of persons per square mile, point symbols varying in size are more appropriate than area symbols varying in graytone. The two areal-unit maps in figure 2.13 illustrate the different graphic strategies required for portraying population size and population density. The map on the left uses *graduated point symbols* positioned near the center of each area; the size of the point symbol represents population size. At its right a *choropleth map* uses graytone symbols that fill the areal units; the relative

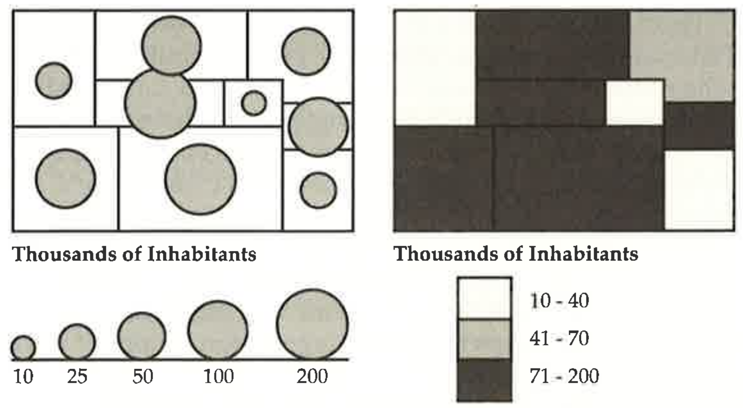

FIGURE 2.14. Map with graduated point symbols (left) using symbol size to portray magnitude demonstrates an appropriate choice of visual variable. Map with graytone area symbols (right) is ill suited to portray magnitude.

darkness of the symbol shows the concentration of population on the land.

Because the visual variables match the measures portrayed, these maps are straightforward and revealing. At the left, big point symbols represent large populations, which occur in both large and small areas, and small point symbols represent small populations. On the choropleth map to the right, a dark symbol indicates many people occupying a relatively small area, whereas a light symbol represents either relatively few people in a small area or many people spread rather thinly across a large area.

Figure 2.14 illustrates the danger of an inappropriate match between measurement and symbol. Both maps portray population size, but the choropleth map at the right is misleading because its area symbols suggest intensity, not magnitude. Note, for instance, that the dark graytone representing a large county with a large but relatively sparsely distributed population also represents a small county with an equally large but much more densely concentrated population. In contrast, the map at the left provides not only a more direct symbolic representation of population size but a clearer picture of area boundaries and area size. The map user should beware of spurious choropleth maps based on magnitude yet suggesting density or concentration.

perimentation with different sets of priorities. Hence computer generalization should make the cartographer more aware of choices, values, and biases. But just because a useful and appropriate tool is available does not mean the mapmaker will use it. Indeed, laziness and lack of curiosity all too often are the most important source of bias.

The choropleth map (introduced as the right-hand elements of figs. 2.13 and 2.14) is perhaps the prime example of this bias by default. Choropleth maps portray geographic patterns for regions composed of areal units such as states, counties, and voting precincts. Usually two to six graytone symbols, on a scale from light to dark, represent two to six nonoverlapping categories for an intensity index such as population density or the percentage of the adult population voting in the last election. The breaks between these categories can markedly affect the mapped pattern, and the cautious map author tests the effects of different sets of class breaks. Mapping software can unwittingly encourage laziness by presenting a map based upon a "default" classification scheme that might, for instance, divide the range of data values into five equal intervals. As a marketing strategy, the software developer uses such default specifications to make the product more attractive by helping the first-time or prospective user experience success. Too commonly, though, the naive or noncritical user accepts this arbitrary display as the standard solution, not merely as a starting point, and ignores the invitation of the program's pull-down menus to explore other approaches to data classification.

Different sets of categories can lead to radically different interpretations. The two maps in figure 3.10, for example, offer very different impressions of the spatial pattern of homes in the northeastern United States still lacking telephones in 1960. Both maps have three classes, portrayed with a graded sequence of graytone area symbols that imply "low," "medium," and "high" rates of phonelessness. Both sets of categories use round-number breaks, which mapmakers for some mysterious reason tend to favor. The map at the left shows a single state, Virginia, in its high, most deficient class, and a single state, Connecticut, in its low, most well-connected class. The casual viewer might attribute these extremes to Virginia's higher proportion of disadvantaged blacks and to Connecticut's af-

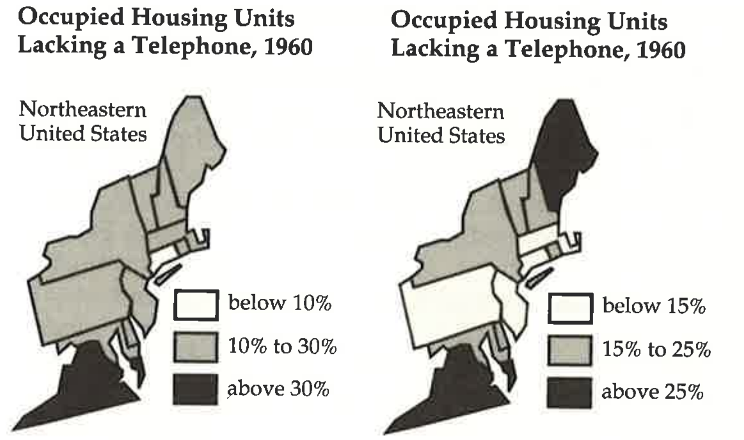

FIGURE 3.10. Different sets of class breaks applied to the same data yield different-looking choropleth maps.

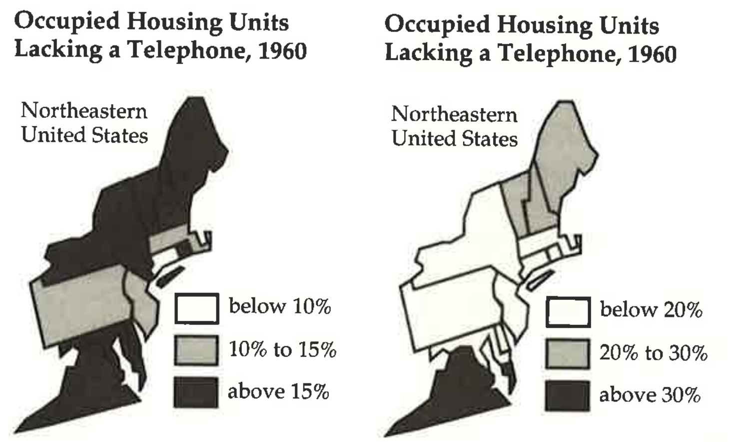

FIGURE 3.11. Class breaks can be manipulated to yield choropleth maps supporting politically divergent interpretations.

fluent suburbs and regard the remaining states as homogeneously "average." In contrast, the map at the right portrays a more balanced distribution of states among the three groups and suggests a different interpretation. Both states in the high category have substantial dispersed rural populations, and all four in the low category are highly urban and industrialized.

Moreover, a smaller middle group suggests less overall homogeneity.

Machiavellian bias can easily manipulate the message of a choropleth map. Figure 3.11, for example, presents two cartographic treatments with substantially different political interpretations. The map on the left uses rounded breaks at 10 percent and 15 percent, forcing most states into its high, poorly connected category and suggesting a Northeast with generally poor communications. Perhaps the government is ineffective in regulating a gouging telecommunications industry or in eradicating poverty. Its counterpart on the right uses rounded breaks at 20 percent and 30 percent to paint a rosier picture, with only one state in the high group and eight in the low, well-served category. Perhaps government regulation is effective, industry benign, and poverty rare.

The four maps in figures 3.10 and 3.11 hold two lessons for the skeptical map reader. First, a single choropleth map presents only one of many possible views of a geographic variable. And second, the white lies of map generalization might also mask the real lies of the political propagandist.

Intuition and Ethics in Map Generalization

Small-scale generalized maps often are authored views of a landscape or a set of spatial data. Like the author of any scholarly work or artistic creation based on reality, the conscientious map author not only examines a variety of sources but relies on extensive experience with the information or region portrayed. Intuition and induction guide the choice of features, graphic hierarchy, and abstraction of detail. The map is as it is because the map author "knows" how it should look. This knowledge, of course, might be faulty, or the resulting graphic interpretation might differ significantly from that of another competent observer. As is often the case, two views might both be valid.