

# Map Scale and Accuracy

SE 453

- ▶ One of the special characteristics of geographic data is that phenomena shown on maps tend to be represented differently at different scales.
- ▶ Typically, as scale decreases, so too does the number of different features, and the detail with which they are represented.
- ▶ Not only printed maps, but also digital geographic data sets that cover extensive areas, tend to be more generalized than data sets that cover limited areas.



- ▶ Accuracy is the relationship between the value of a measurement and the “true "value of the dimension being measured’
- ▶ The “true "value is a concept as no measurement can be performed perfectly without error.
- ▶ The objective is to minimize error to acceptable levels.
- ▶ Accuracy is how close a measured value is to the actual (true) value.



- ▶ Accuracy is the degree to which information on a map or in a digital database matches true or accepted values.
- ▶ Accuracy is an issue pertaining to the quality of data and the number of errors contained in a dataset or map, it is possible to consider horizontal and vertical accuracy with respect to geographic position, as well as attribute, conceptual, and logical accuracy.
  - The level of accuracy required for particular applications varies greatly.
  - Highly accurate data can be very difficult and costly to produce and compile.

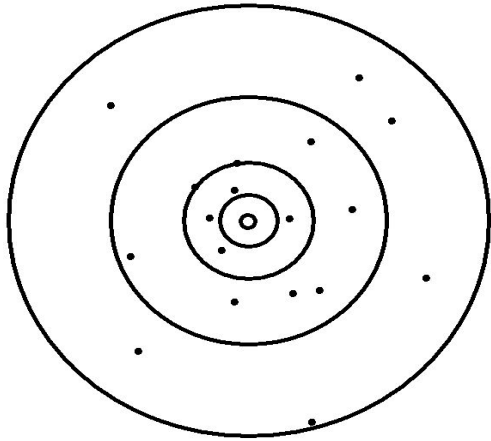


- ▶ Precision describes the degree of refinement with which the measurement is made'

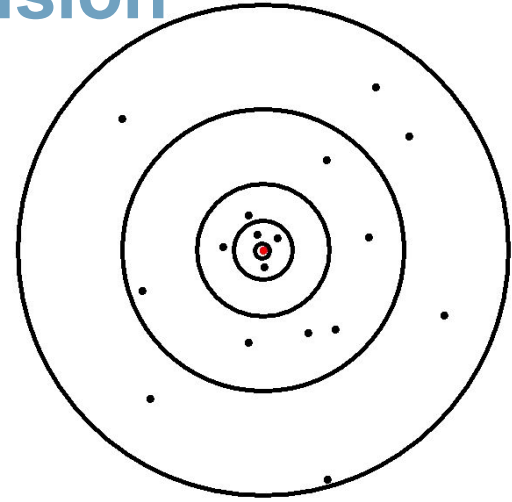
## Repeatability

- ▶ Confidence levels, I.e. 90% probability.
- ▶ Precision is how close the measured values are to each other.

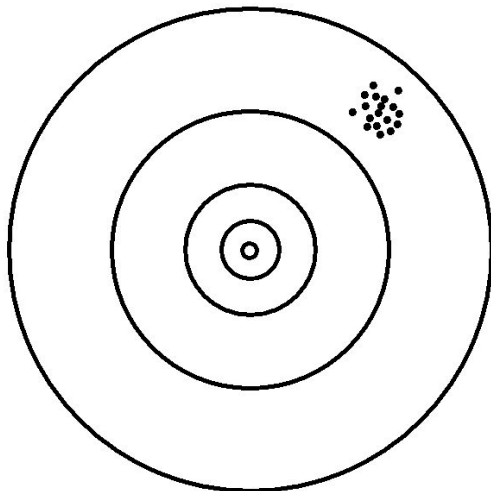
# Accuracy And Precision



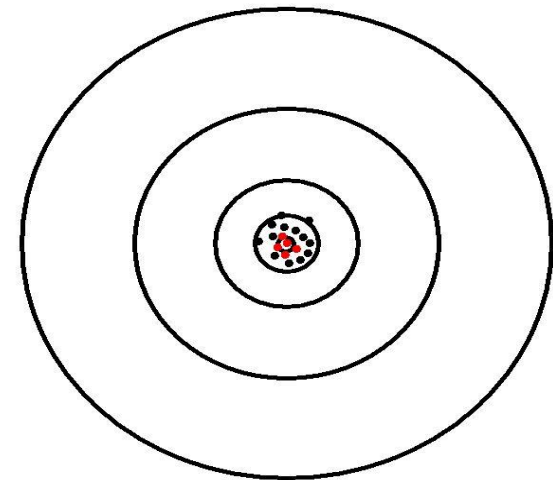
**Low Accuracy &  
Low Precision**



**High Accuracy & Low Precision**

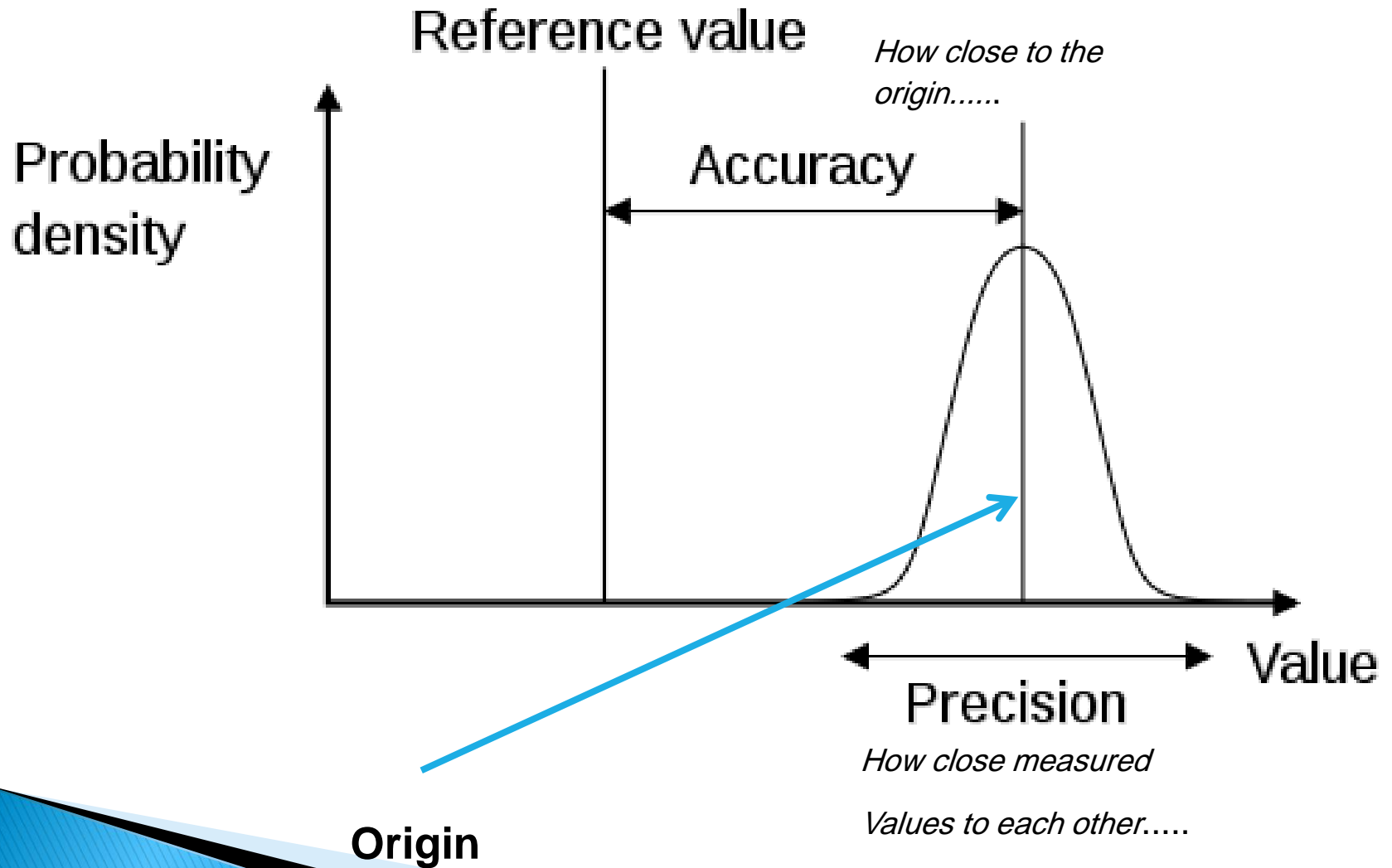


**Low Accuracy & High Precision**



**High Accuracy & High Precision**

**Finally**.....in Statistics explanation.....



- ▶ Often overlooked and misunderstood.
- ▶ The objective is to minimize error to acceptable levels.
- ▶ Error is unavoidable, but must be acknowledged, quantified and planned for.
- ▶ An error is the difference between a measured, or observed, value and the true value'.



- ▶ This applies to both horizontal and vertical positions.
- ▶ Accuracy and precision are a function of the scale at which a map (paper or digital) was created.
- ▶ The mapping standards employed by the United States Geological Survey specify that:
  - "requirements for meeting horizontal accuracy as 90 percent of all measurable points must be within 1 / 30th of an inch for maps at a scale of 1:20,000 or larger, and 1 / 50th of an inch for maps at scales smaller than 1:20,000."

- ▶ 1:1,200  $\pm$  3.33 feet
- ▶ 1:2,400  $\pm$  6.67 feet
- ▶ 1:4,800  $\pm$  13.33 feet
- ▶ 1:10,000  $\pm$  27.78 feet
- ▶ 1:12,000  $\pm$  33.33 feet
- ▶ 1:24,000  $\pm$  40.00 feet
- ▶ 1:63,360  $\pm$  105.60 feet
- ▶ 1:100,000  $\pm$  166.67 feet

- ▶ for maps at a scale of 1:20,000 or larger:
  - $Exp = 1/30 * 1200 = 40 \text{ inch} = 40/12 \text{ ft} = 3.33 \text{ ft}$
- ▶ for maps at scales smaller than 1:20,000:
  - $Exp = 1/50 * 100,000 = 2000 \text{ inch} = 166.66 \text{ ft}$

Scale	horizontal accuracy(m)
25000	12.7
50000	25.4
100000	50.8
250000	127
500000	254
1000000	508

$$2.54/50 * \text{Scale}/100$$

# Calculating the accuracy

- ▶ A data set's accuracy is tested by comparing the coordinates of several points within the data set to the coordinates of the same points from an independent data set of greater accuracy.
- ▶ Points used for this comparison must be well-defined. They must be easy to find and measure in both the data set being tested and in the independent data set.

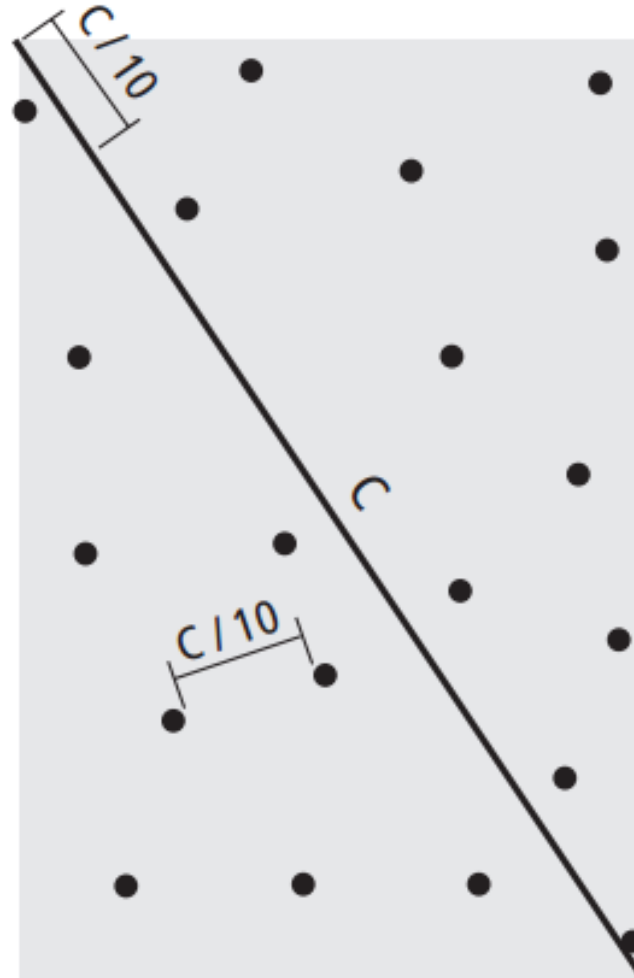
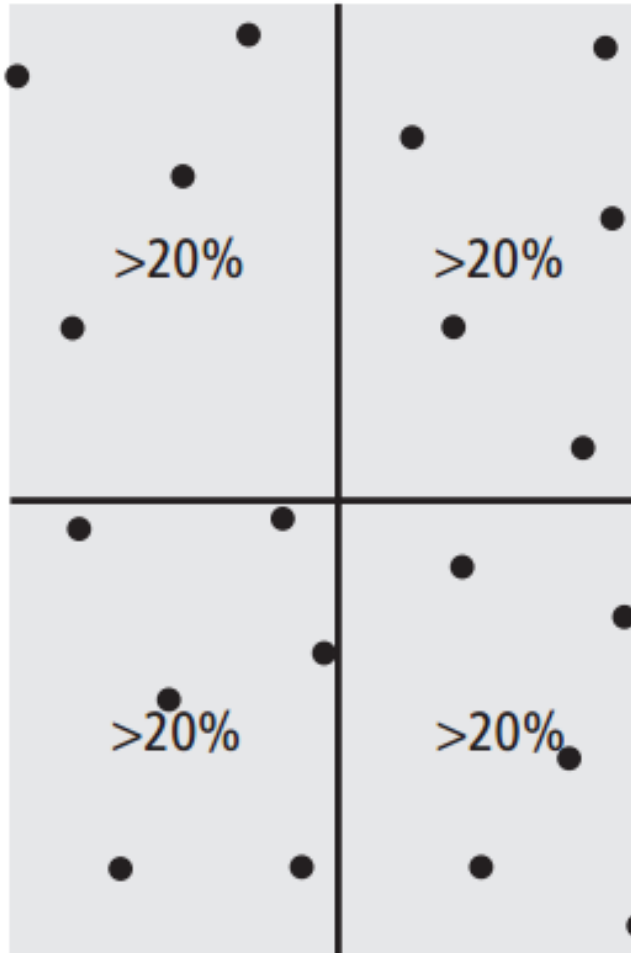


- ▶ Independent data set must be acquired separately from the data set being tested. It should be of the highest accuracy available.
- ▶ In general, the independent data set should be three times more accurate than the expected accuracy of the test data set.
- ▶ Unfortunately, this is not always possible or practical. If an independent data set that meets this criterion cannot be found, a data set of the highest accuracy feasible should be used.

- ▶ The areal extent of the independent data set should approximate that of the original data set.
- ▶ When the tested data set covers a rectangular area and is believed to be uniformly accurate, an ideal distribution of test points allows for at least 20 percent to be located in each quadrant
- ▶ Test points should be spaced at intervals of at least 10 percent of the diagonal distance across the rectangular data set;



# The ideal distribution





- ▶ The NSSDA statistic is calculated by first filling out the information requested in the appropriate table and then computing three values:
  - the sum of the set of squared differences between the test data set coordinate values and the independent data set coordinate values,
  - the average of the sum by dividing the sum by the number of test points being evaluated
  - the root mean square error statistic, which is simply the square root of the average.

NSSDA = National Standard for Spatial Data Accuracy

- ▶ In any data collection project there is a fundamental tradeoff between quality, speed, and price.
- ▶ Collecting high-quality data quickly is possible, but it is also very expensive.
- ▶ If price is a key consideration then lower-quality data can be collected over a longer period

