

The Preliminary Scholastic Aptitude Test (PSAT) is taken by about 1.3 million high school sophomores and juniors every year. The test is comprised of three sections—Mathematics, Critical Reading, and Writing—each of which is scored on a scale of 20 to 80 points. The sum of these scores is called the Selection Index. You will use statistical methods to analyze PSAT results.

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# 8.1 Taking the PSAT

## Measures of Central Tendency

### Objectives

In this lesson, you will:

- Create a stem-and-leaf plot.
- Determine the distribution of a data set.
- Determine the mean, median, and mode of a data set.
- Compare the mean and median for different distributions.

### Key Terms

- stem-and-leaf plot
- distribution
- mean
- measure of central tendency
- median
- mode



You and your friends plan to take the PSAT (Preliminary Scholastic Aptitude Test). You learn that this test requires 2 hours and 10 minutes, is usually taken by students during their sophomore or junior years, and includes math, critical reading, and writing questions. You also find out that during the 2004–2005 school year, about 1.2 million sophomores took the PSAT.

## Problem 1 How Did Your State Score?

- A. The table shows the average PSAT score for each state. To analyze the scores, you can use a *stem-and-leaf plot*. A **stem-and-leaf plot** is a data display that helps you to see how the data are spread out. The *leaves* of the data are made from the digits with the least place value. The *stems* of the data are made from the digits in the remaining place values. Each data value is listed once in the plot. Complete the plot. The first data value, 39.3, is done for you

| PSAT Scores |    |      |    |
|-------------|----|------|----|
| 39.3        | NV | 43.9 | KY |
| 41.1        | GA | 44.1 | PA |
| 41.2        | FL | 44.8 | CA |
| 41.6        | ME | 45.0 | VA |
| 41.7        | SC | 45.1 | NC |
| 42.0        | MD | 45.4 | CT |
| 42.3        | DE | 45.9 | NY |
| 42.3        | MS | 46.0 | NJ |
| 42.3        | OK | 46.4 | OH |
| 42.5        | RI | 46.7 | MA |
| 42.8        | LA | 46.8 | HI |
| 43.0        | NM | 46.8 | NH |
| 43.6        | TX | 46.9 | IN |

| PSAT Scores |    |      |    |
|-------------|----|------|----|
| 47.3        | AR | 49.9 | KS |
| 47.4        | AZ | 50.2 | CO |
| 47.4        | WV | 50.8 | IL |
| 47.5        | AL | 50.8 | MT |
| 47.8        | VT | 50.8 | WY |
| 47.9        | AK | 51.5 | MO |
| 48.5        | UT | 51.5 | NE |
| 48.9        | OR | 51.5 | WI |
| 49.0        | WA | 51.7 | SD |
| 49.1        | TN | 52.7 | IA |
| 49.7        | MI | 52.9 | MN |
| 49.9        | ID | 53.2 | ND |



| Stems | Leaves               | Key                             |
|-------|----------------------|---------------------------------|
| 39    | 3                    | $47   5 =$ <input type="text"/> |
| 40    | <input type="text"/> |                                 |
| 41    | <input type="text"/> |                                 |
| 42    | <input type="text"/> |                                 |
| 43    | <input type="text"/> |                                 |
| 44    | <input type="text"/> |                                 |
| 45    | <input type="text"/> |                                 |
| 46    | <input type="text"/> |                                 |
| 47    | <input type="text"/> |                                 |
| 48    | <input type="text"/> |                                 |
| 49    | <input type="text"/> |                                 |
| 50    | <input type="text"/> |                                 |
| 51    | <input type="text"/> |                                 |
| 52    | <input type="text"/> |                                 |
| 53    | <input type="text"/> |                                 |

Be sure to include a key that shows what the stems and leaves indicate. Complete the key in your stem-and-leaf plot.

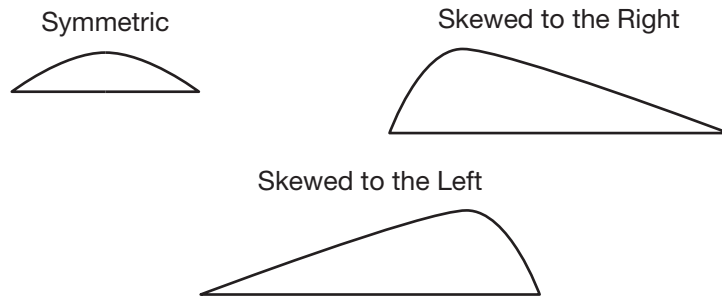
- B.** How does the stem-and-leaf plot display the data?
- C.** What is the highest average score for a state? What is the lowest average score for a state?
- D.** Based on your stem-and-leaf plot, what would you estimate is the average PSAT score for the United States?

## Investigate Problem 1

8

- Just the Math: Distributions** Rotate the page with your stem-and-leaf plot  $90^\circ$  in a counterclockwise direction so that the leaves go up instead of to the right. The way in which the data are distributed, such as being spread out or clustered together, is the **distribution** of the data. Describe the shape of the distribution that you see in your rotated stem-and-leaf plot.

The shape of the distribution can reveal a lot of information about the data. There are many different distributions, but the most common are symmetric, skewed to the right, and skewed to the left.



- In your own words, explain how to draw each distribution.
- What type of distribution does the PSAT score data have?
- Is it easier to see the distribution in the stem-and-leaf plot or the table?

5. **Just the Math: Mean, Median, and Mode** The average PSAT score for each state is shown in order from least to greatest starting from the left. Locate your state's average PSAT score. Did the students who took the PSAT in your state do well?

| PSAT Scores |    |      |    |
|-------------|----|------|----|
| 39.3        | NV | 43.9 | KY |
| 41.1        | GA | 44.1 | PA |
| 41.2        | FL | 44.8 | CA |
| 41.6        | ME | 45.0 | VA |
| 41.7        | SC | 45.1 | NC |
| 42.0        | MD | 45.4 | CT |
| 42.3        | DE | 45.9 | NY |
| 42.3        | MS | 46.0 | NJ |
| 42.3        | OK | 46.4 | OH |
| 42.5        | RI | 46.7 | MA |
| 42.8        | LA | 46.8 | HI |
| 43.0        | NM | 46.8 | NH |
| 43.6        | TX | 46.9 | IN |

| PSAT Scores |    |      |    |
|-------------|----|------|----|
| 47.3        | AR | 49.9 | KS |
| 47.4        | AZ | 50.2 | CO |
| 47.4        | WV | 50.8 | IL |
| 47.5        | AL | 50.8 | MT |
| 47.8        | VT | 50.8 | WY |
| 47.9        | AK | 51.5 | MO |
| 48.5        | UT | 51.5 | NE |
| 48.9        | OR | 51.5 | WI |
| 49.0        | WA | 51.7 | SD |
| 49.1        | TN | 52.7 | IA |
| 49.7        | MI | 52.9 | MN |
| 49.9        | ID | 53.2 | ND |

One number that is often used to describe a set of data is the **mean** or arithmetic mean. The mean is also called the average. The mean is the sum of all the data values divided by the number of values in the data set. We write the mean as

$$\bar{x} = \frac{\sum x}{n},$$

where  $\Sigma$  is the symbol for the sum of all the  $x$ -values (data values) and

$n$  is the number of values. What is the mean of the test scores in the table? Round your answer to the nearest hundredth.

Approximately what percent of the scores are above the mean? Approximately what percent of the scores are below the mean?

When we talk about a mean score, we are trying to determine a single value that best represents the performance of a group. This single value is a **measure of central tendency**. It is a value that represents a typical value in a data set.

## Take Note

When you have an even number of values in a data set, you can determine the median by calculating the mean of the middle two numbers. For instance, in the data set 12, 13, 15, 16, 18, 19, the median is the mean of 15 and 16, which is  $\frac{15 + 16}{2}$ , or 15.5.

6. Another measure of central tendency is the **median**, the middle score of the data, which is calculated by listing all the data values in order and determining the value that is exactly in the middle. Use your stem-and-leaf plot to determine the median score. Interpret this value in terms of the problem situation. Where does your state fit?

7. A third measure of central tendency is the *mode* of the data. The **mode** is the value in the data set that appears most often. If two values occur in the data set the same number of times, then each value is a mode and the data set is *bimodal*. If three values occur in the data set the same number of times, then each value is a mode and the data set is *trimodal*. Which test score appears the greatest number of times?

What is the mode of the test scores?

8. **Just the Math: Mean, Median, Mode, and Distributions** When a distribution is symmetric, the mean and median are equal. How do you think the mean compares to the median in a distribution that is skewed to the left?

How do you think the mean compares to the median in a distribution that is skewed to the right?

Draw representations of two sets of data, one for a distribution that is skewed to the left and one for a distribution that is skewed to the right. Then mark the possible mean and median on each distribution.



9. This set of data is a set of PSAT scores from those students in a particular class at your school who took the test. Create a stem-and-leaf plot of the data and determine the distribution of the data. Then analyze the data by determining the mean, median, and mode. Show all your work. Finally, draw a representation of the data and mark the mean and median on the distribution.

Test scores: 36, 49, 16, 31, 21, 52, 29, 49, 48, 32, 42, 49, 44

|  |  |
|--|--|
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

### Take Note

Whenever you see the share with the class icon, your group should prepare a short presentation to share with the class that describes how you solved the problem. Be prepared to ask questions during other groups' presentations and to answer questions during your presentation.



10. Based on your results in Question 9, decide which measure of central tendency, the median or the mean, is the better representation of the test scores of the class.



# 8.2 How Many People?

## Population Data and Samples

### Objectives

In this lesson, you will:

- Analyze a large data set by collecting and comparing samples.
- Calculate the median and quartiles of samples.
- Construct box-and-whisker plots.
- Compare samples using box-and-whisker plots.

### Key Terms

- sample
- absolute deviation
- average absolute deviation

## Problem 1 Pick 'Em

The table at the end of this lesson lists the population of 542 cities and towns in Georgia in 2002.

1. List five characteristics of the population data.
2. A **sample** is a subset of a larger data set. Choose a sample of ten cities that you think best characterizes the data set. List those cities and their populations in the table.



| City/Town | Population | Absolute Deviation from Mean | Absolute Deviation from Median |
|-----------|------------|------------------------------|--------------------------------|
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |

3. How did you decide which cities to include in the sample?
4. Calculate each measure of central tendency for your sample.
  - a. Mean
  - b. Median
  - c. Mode
5. Calculate each quartile for your sample.
  - a. First quartile
  - b. Third quartile
6. Graph a box-and-whisker plot of your sample.

The **absolute deviation** is the absolute value of the difference between a data value and a measure of central tendency.

$$\text{absolute deviation} = |x_i - (\text{mean, median or mode})|$$

The absolute deviation can be used to describe the spread or variance of a sample.

7. For each data value in your sample, calculate the absolute deviation from the mean. Enter these values in the third column of the table from Question 2.
8. For each data value in your sample, calculate the absolute deviation from the median. Enter these values in the fourth column of the table from Question 2.

9. Calculate the **average absolute deviation** from the mean.
10. Calculate the average absolute deviation from the median.
11. Based on your calculations, what can you conclude about the population of Georgia's towns and cities?



## Problem 2 Pick 'Em Again

As a class, decide on some criterion for choosing a second sample from the population data.

- Choose a sample of ten cities using the criterion. List those cities and their populations in the table.

| City/Town | Population | Absolute Deviation from Mean | Absolute Deviation from Median |
|-----------|------------|------------------------------|--------------------------------|
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |
|           |            |                              |                                |

2. Calculate each measure of central tendency for your sample.
  - a. Mean
  
  
  
  
  
  
  
  
  
  
  - b. Median
  
  
  
  
  
  
  
  
  
  
  - c. Mode
  
3. Calculate each quartile for your sample.
  - a. First quartile
  
  
  
  
  
  
  
  
  
  
  - b. Third quartile
  
4. Graph a box-and-whisker plot of your sample.
  
  
  
  
  
  
  
  
  
  
5. For each data value in your sample, calculate the absolute deviation from the mean. Enter these values in the third column of the table from Question 2.
  
6. For each data value in your sample, calculate the absolute deviation from the median. Enter these values in the fourth column of the table from Question 2.
  
7. Calculate the average absolute deviation from the mean.
  
  
  
  
  
  
  
  
  
  
8. Calculate the average absolute deviation from the median.

9. Based on your calculations, what can you conclude about the population of Georgia's towns and cities?



Be prepared to share your findings with the class.

### City Population for Georgia 2000 Census

|    | CITY             | TOTAL  |
|----|------------------|--------|
| 1  | Abbeville City   | 2298   |
| 2  | Acworth City     | 13,422 |
| 3  | Adairsville City | 2542   |
| 4  | Adel City        | 5307   |
| 5  | Adrian City      | 579    |
| 6  | Ailey            | 394    |
| 7  | Alamo            | 1943   |
| 8  | Alapaha          | 682    |
| 9  | Albany           | 76,939 |
| 10 | Aldora           | 98     |
| 11 | Allenhurst       | 788    |
| 12 | Allentown        | 287    |
| 13 | Alma             | 3236   |
| 14 | Alpharetta       | 34,854 |
| 15 | Alston           | 159    |
| 16 | Alto             | 876    |
| 17 | Ambrose          | 320    |
| 18 | Americus         | 17,013 |
| 19 | Andersonville    | 331    |
| 20 | Arabi            | 456    |
| 21 | Aragon           | 1039   |
| 22 | Arcade           | 1643   |
| 23 | Argyle           | 151    |
| 24 | Arlington        | 1602   |

|    | CITY             | TOTAL   |
|----|------------------|---------|
| 25 | Arnoldsville     | 312     |
| 26 | Ashburn          | 4419    |
| 27 | Athens-Clarke    | 100,266 |
| 28 | Atlanta          | 416,474 |
| 29 | Attapulcus       | 492     |
| 30 | Auburn           | 6904    |
| 31 | Augusta-Richmond | 195,182 |
| 32 | Austell          | 5359    |
| 33 | Avalon           | 278     |
| 34 | Avera            | 217     |
| 35 | Avondale Estates | 2609    |
| 36 | Baconton         | 804     |
| 37 | Bainbridge       | 11,722  |
| 38 | Baldwin          | 2425    |
| 39 | Ball Ground      | 730     |
| 40 | Barnesville      | 5972    |
| 41 | Bartow           | 223     |
| 42 | Barwick          | 444     |
| 43 | Baxley           | 4150    |
| 44 | Bellville        | 130     |
| 45 | Berkeley Lake    | 1695    |
| 46 | Berlin           | 595     |
| 47 | Bethlehem        | 716     |
| 48 | Between          | 148     |

|    | CITY         | TOTAL  |
|----|--------------|--------|
| 49 | Bibb City    | 510    |
| 50 | Bishop       | 146    |
| 51 | Blackshear   | 3283   |
| 52 | Blairsville  | 659    |
| 53 | Blakely      | 5696   |
| 54 | Bloomingdale | 2665   |
| 55 | Blue Ridge   | 1210   |
| 56 | Bluffton     | 118    |
| 57 | Blythe       | 718    |
| 58 | Bogart       | 1049   |
| 59 | Boston       | 1417   |
| 60 | Bostwick     | 322    |
| 61 | Bowdon       | 1959   |
| 62 | Bowersville  | 334    |
| 63 | Bowman       | 898    |
| 64 | Braselton    | 1206   |
| 65 | Braswell     | 80     |
| 66 | Bremen       | 4579   |
| 67 | Brinson      | 225    |
| 68 | Bronwood     | 513    |
| 69 | Brooklet     | 1113   |
| 70 | Brooks       | 553    |
| 71 | Broxton      | 1428   |
| 72 | Brunswick    | 15,600 |
| 73 | Buchanan     | 941    |
| 74 | Buckhead     | 205    |
| 75 | Buena Vista  | 1664   |
| 76 | Buford       | 10,668 |
| 77 | Butler       | 1907   |
| 78 | Byromville   | 415    |
| 79 | Byron        | 2887   |
| 80 | Cadwell      | 329    |
| 81 | Cairo        | 9239   |
| 82 | Calhoun      | 10,667 |
| 83 | Camak        | 165    |

|     | CITY           | TOTAL   |
|-----|----------------|---------|
| 84  | Camilla        | 5669    |
| 85  | Canon          | 755     |
| 86  | Canton         | 7709    |
| 87  | Carl           | 205     |
| 88  | Carlton        | 233     |
| 89  | Carnesville    | 541     |
| 90  | Carrollton     | 19,843  |
| 91  | Cartersville   | 15,925  |
| 92  | Cave Spring    | 975     |
| 93  | Cecil          | 265     |
| 94  | Cedartown      | 9470    |
| 95  | Centerville    | 4278    |
| 96  | Centralhatchee | 383     |
| 97  | Chamblee       | 9552    |
| 98  | Chatsworth     | 3531    |
| 99  | Chauncey       | 295     |
| 100 | Chester        | 305     |
| 101 | Chickamauga    | 2245    |
| 102 | Clarkesville   | 1248    |
| 103 | Clarkston      | 7231    |
| 104 | Claxton        | 2276    |
| 105 | Clayton        | 2019    |
| 106 | Clermont       | 419     |
| 107 | Cleveland      | 1907    |
| 108 | Climax         | 297     |
| 109 | Cobbtown       | 311     |
| 110 | Cochran        | 4455    |
| 111 | Cohutta        | 582     |
| 112 | Colbert        | 488     |
| 113 | Coleman        | 149     |
| 114 | College Park   | 20,382  |
| 115 | Collins        | 528     |
| 116 | Colquitt       | 1939    |
| 117 | Columbus       | 185,781 |
| 118 | Comer          | 1052    |

|     | CITY          | TOTAL  |
|-----|---------------|--------|
| 119 | Commerce      | 5292   |
| 120 | Concord       | 336    |
| 121 | Conyers       | 10,689 |
| 122 | Coolidge      | 552    |
| 123 | Cordele       | 11,608 |
| 124 | Corinth       | 213    |
| 125 | Cornelia      | 3674   |
| 126 | Covington     | 11,547 |
| 127 | Crawford      | 807    |
| 128 | Crawfordville | 572    |
| 129 | Culloden      | 223    |
| 130 | Cumming       | 4220   |
| 131 | Cusseta       | 1196   |
| 132 | Cuthbert      | 3731   |
| 133 | Dacula        | 3848   |
| 134 | Dahlonega     | 3638   |
| 135 | Daisy         | 126    |
| 136 | Dallas        | 5056   |
| 137 | Dalton        | 27,912 |
| 138 | Damascus      | 277    |
| 139 | Danielsville  | 457    |
| 140 | Danville      | 373    |
| 141 | Darien        | 1719   |
| 142 | Dasher        | 834    |
| 143 | Davisboro     | 1544   |
| 144 | Dawson        | 5058   |
| 145 | Dawsonville   | 619    |
| 146 | Dearing       | 441    |
| 147 | Decatur       | 18,147 |
| 148 | Deepstep      | 132    |
| 149 | Demorest      | 1465   |
| 150 | Denton        | 269    |
| 151 | De Soto       | 214    |
| 152 | Dexter        | 509    |
| 153 | Dillard       | 198    |

|     | CITY           | TOTAL  |
|-----|----------------|--------|
| 154 | Doerun         | 828    |
| 155 | Donalsonville  | 2796   |
| 156 | Dooling        | 163    |
| 157 | Doraville      | 9862   |
| 158 | Douglas        | 10,639 |
| 159 | Douglasville   | 20,065 |
| 160 | Dublin         | 15,857 |
| 161 | Dudley         | 447    |
| 162 | Duluth         | 22,122 |
| 163 | Du Pont        | 139    |
| 164 | East Dublin    | 2484   |
| 165 | East Ellijay   | 707    |
| 166 | Eastman        | 5440   |
| 167 | East Point     | 39,595 |
| 168 | Eatonton       | 6764   |
| 169 | Edge Hill      | 30     |
| 170 | Edison         | 1340   |
| 171 | Elberton       | 4743   |
| 172 | Ellaville      | 1609   |
| 173 | Ellenton       | 336    |
| 174 | Ellijay        | 1584   |
| 175 | Emerson        | 1092   |
| 176 | Enigma         | 869    |
| 177 | Ephesus        | 388    |
| 178 | Eton           | 319    |
| 179 | Euharlee       | 3208   |
| 180 | Fairburn       | 5464   |
| 181 | Fairmount      | 745    |
| 182 | Fargo          | 380    |
| 183 | Fayetteville   | 11,148 |
| 184 | Fitzgerald     | 8758   |
| 185 | Flemington     | 369    |
| 186 | Flovilla       | 652    |
| 187 | Flowery Branch | 1806   |
| 188 | Folkston       | 2178   |

|     | CITY             | TOTAL  |
|-----|------------------|--------|
| 189 | Forest Park      | 21,447 |
| 190 | Forsyth          | 3776   |
| 191 | Fort Gaines      | 1110   |
| 192 | Fort Oglethorpe  | 6940   |
| 193 | Fort Valley      | 8005   |
| 194 | Franklin         | 902    |
| 195 | Franklin Springs | 762    |
| 196 | Funston          | 426    |
| 197 | Gainesville      | 25,578 |
| 198 | Garden City      | 11,289 |
| 199 | Garfield         | 152    |
| 200 | Gay              | 149    |
| 201 | Geneva           | 114    |
| 202 | Georgetown       | 973    |
| 203 | Gibson           | 694    |
| 204 | Gillsville       | 195    |
| 205 | Girard           | 227    |
| 206 | Glennville       | 3641   |
| 207 | Glenwood         | 884    |
| 208 | Good Hope        | 210    |
| 209 | Gordon           | 2152   |
| 210 | Graham           | 312    |
| 211 | Grantville       | 1309   |
| 212 | Gray             | 1811   |
| 213 | Grayson          | 765    |
| 214 | Greensboro       | 3238   |
| 215 | Greenville       | 946    |
| 216 | Griffin          | 23,451 |
| 217 | Grovetown        | 6089   |
| 218 | Gumbranch        | 273    |
| 219 | Guyton           | 917    |
| 220 | Hagan            | 898    |
| 221 | Hahira           | 1626   |
| 222 | Hamilton         | 307    |
| 223 | Hampton          | 3857   |

|     | CITY           | TOTAL  |
|-----|----------------|--------|
| 224 | Hapeville      | 6180   |
| 225 | Haralson       | 144    |
| 226 | Harlem         | 1814   |
| 227 | Harrison       | 509    |
| 228 | Hartwell       | 4188   |
| 229 | Hawkinsville   | 3280   |
| 230 | Hazlehurst     | 3787   |
| 231 | Helen          | 430    |
| 232 | Helena         | 2307   |
| 233 | Hephzibah      | 3880   |
| 234 | Hiawassee      | 808    |
| 235 | Higgston       | 316    |
| 236 | Hiltonia       | 421    |
| 237 | Hinesville     | 30,392 |
| 238 | Hiram          | 1361   |
| 239 | Hoboken        | 463    |
| 240 | Hogansville    | 2774   |
| 241 | Holly Springs  | 3195   |
| 242 | Homeland       | 765    |
| 243 | Homer          | 950    |
| 244 | Homerville     | 2803   |
| 245 | Hoschton       | 1070   |
| 246 | Hull           | 160    |
| 247 | Ideal          | 518    |
| 248 | Ila            | 328    |
| 249 | Iron City      | 321    |
| 250 | Irwinton       | 587    |
| 251 | Ivey           | 1100   |
| 252 | Jackson        | 3934   |
| 253 | Jacksonville   | 118    |
| 254 | Jakin          | 157    |
| 255 | Jasper         | 2167   |
| 256 | Jefferson      | 3825   |
| 257 | Jeffersonville | 1209   |
| 258 | Jenkinsburg    | 203    |



|     | CITY             | TOTAL  |
|-----|------------------|--------|
| 259 | Jersey           | 163    |
| 260 | Jesup            | 9279   |
| 261 | Jonesboro        | 3829   |
| 262 | Junction City    | 179    |
| 263 | Kennesaw         | 21,675 |
| 264 | Keysville        | 180    |
| 265 | Kingsland        | 10,506 |
| 266 | Kingston         | 659    |
| 267 | Kite             | 241    |
| 268 | La Fayette       | 6702   |
| 269 | LaGrange         | 25,998 |
| 270 | Lake City        | 2886   |
| 271 | Lakeland         | 2730   |
| 272 | Lake Park        | 549    |
| 273 | Lavonia          | 1827   |
| 274 | Lawrenceville    | 22,397 |
| 275 | Leary            | 666    |
| 276 | Leesburg         | 2633   |
| 277 | Lenox            | 889    |
| 278 | Leslie           | 455    |
| 279 | Lexington        | 239    |
| 280 | Lilburn          | 11,307 |
| 281 | Lilly            | 221    |
| 282 | Lincolnton       | 1595   |
| 283 | Lithia Springs   | 2072   |
| 284 | Lithonia         | 2187   |
| 285 | Locust Grove     | 2322   |
| 286 | Loganville       | 5435   |
| 287 | Lone Oak         | 104    |
| 288 | Lookout Mountain | 1617   |
| 289 | Louisville       | 2712   |
| 290 | Lovejoy          | 2495   |
| 291 | Ludowici         | 1440   |
| 292 | Lula             | 1438   |
| 293 | Lumber City      | 1247   |

|     | CITY          | TOTAL  |
|-----|---------------|--------|
| 294 | Lumpkin       | 1369   |
| 295 | Luthersville  | 783    |
| 296 | Lyerly        | 488    |
| 297 | Lyons         | 4169   |
| 298 | McCaysville   | 1071   |
| 299 | McDonough     | 8493   |
| 300 | McIntyre      | 718    |
| 301 | Macon         | 97,255 |
| 302 | McRae         | 2682   |
| 303 | Madison       | 3636   |
| 304 | Manassas      | 100    |
| 305 | Manchester    | 3988   |
| 306 | Mansfield     | 392    |
| 307 | Marietta      | 58,748 |
| 308 | Marshallville | 1335   |
| 309 | Martin        | 311    |
| 310 | Maxeys        | 210    |
| 311 | Maysville     | 1247   |
| 312 | Meansville    | 192    |
| 313 | Meigs         | 1090   |
| 314 | Menlo         | 485    |
| 315 | Metter        | 3879   |
| 316 | Midville      | 457    |
| 317 | Midway        | 1100   |
| 318 | Milan         | 1012   |
| 319 | Milledgeville | 18,757 |
| 320 | Millen        | 3492   |
| 321 | Milner        | 522    |
| 322 | Mitchell      | 173    |
| 323 | Molena        | 475    |
| 324 | Monroe        | 11,407 |
| 325 | Montezuma     | 3999   |
| 326 | Monticello    | 2428   |
| 327 | Montrose      | 154    |
| 328 | Moreland      | 393    |

|     | CITY              | TOTAL  |
|-----|-------------------|--------|
| 329 | Morgan            | 1464   |
| 330 | Morganton         | 299    |
| 331 | Morrow            | 4882   |
| 332 | Morven            | 634    |
| 333 | Moultrie          | 14,387 |
| 334 | Mountain City     | 829    |
| 335 | Mountain Park     | 506    |
| 336 | Mount Airy        | 604    |
| 337 | Mount Vernon      | 2082   |
| 338 | Mount Zion        | 1275   |
| 339 | Nahunta           | 930    |
| 340 | Nashville         | 4697   |
| 341 | Nelson            | 626    |
| 342 | Newborn           | 520    |
| 343 | Newington         | 322    |
| 344 | Newnan            | 16,242 |
| 345 | Newton            | 851    |
| 346 | Nicholls          | 1008   |
| 347 | Nicholson         | 1247   |
| 348 | Norcross          | 8410   |
| 349 | Norman Park       | 849    |
| 350 | North High Shoals | 439    |
| 351 | Norwood           | 299    |
| 352 | Nunez             | 131    |
| 353 | Oak Park          | 366    |
| 354 | Oakwood           | 2689   |
| 355 | Ochlocknee        | 605    |
| 356 | Ocilla            | 3270   |
| 357 | Oconee            | 280    |
| 358 | Odum              | 414    |
| 359 | Offerman          | 403    |
| 360 | Oglethorpe        | 1200   |
| 361 | Oliver            | 253    |
| 362 | Omega             | 1340   |
| 363 | Orchard Hill      | 230    |

|     | CITY           | TOTAL  |
|-----|----------------|--------|
| 364 | Oxford         | 1892   |
| 365 | Palmetto       | 3400   |
| 366 | Parrott        | 156    |
| 367 | Patterson      | 627    |
| 368 | Pavo           | 711    |
| 369 | Payne          | 178    |
| 370 | Peachtree City | 31,580 |
| 371 | Pearson        | 1805   |
| 372 | Pelham         | 4126   |
| 373 | Pembroke       | 2379   |
| 374 | Pendergrass    | 431    |
| 375 | Perry          | 9602   |
| 376 | Pinehurst      | 307    |
| 377 | Pine Lake      | 621    |
| 378 | Pine Mountain  | 1141   |
| 379 | Pineview       | 532    |
| 380 | Pitts          | 308    |
| 381 | Plains         | 637    |
| 382 | Plainville     | 257    |
| 383 | Pooler         | 6239   |
| 384 | Portal         | 597    |
| 385 | Porterdale     | 1281   |
| 386 | Port Wentworth | 3276   |
| 387 | Poulan         | 946    |
| 388 | Powder Springs | 12,481 |
| 389 | Preston        | 453    |
| 390 | Pulaski        | 261    |
| 391 | Quitman        | 4638   |
| 392 | Ranger         | 85     |
| 393 | Ray City       | 746    |
| 394 | Rayle          | 139    |
| 395 | Rebecca        | 246    |
| 396 | Register       | 164    |
| 397 | Reidsville     | 2235   |
| 398 | Remerton       | 847    |

|     | CITY          | TOTAL   |
|-----|---------------|---------|
| 399 | Rentz         | 304     |
| 400 | Resaca        | 815     |
| 401 | Rest Haven    | 151     |
| 402 | Reynolds      | 1036    |
| 403 | Rhine         | 422     |
| 404 | Riceboro      | 736     |
| 405 | Richland      | 1794    |
| 406 | Richmond Hill | 6959    |
| 407 | Ridgelyville  | 124     |
| 408 | Rincon        | 4376    |
| 409 | Ringgold      | 2422    |
| 410 | Riverdale     | 12,478  |
| 411 | Riverside     | 57      |
| 412 | Roberta       | 808     |
| 413 | Rochelle      | 1415    |
| 414 | Rockmart      | 3870    |
| 415 | Rocky Ford    | 186     |
| 416 | Rome          | 34,980  |
| 417 | Roopville     | 177     |
| 418 | Rossville     | 3511    |
| 419 | Roswell       | 79,334  |
| 420 | Royston       | 2493    |
| 421 | Rutledge      | 707     |
| 422 | St. Marys     | 13,761  |
| 423 | Sale City     | 319     |
| 424 | Sandersville  | 6144    |
| 425 | Santa Claus   | 237     |
| 426 | Sardis        | 1171    |
| 427 | Sasser        | 393     |
| 428 | Savannah      | 131,510 |
| 429 | Scotland      | 300     |
| 430 | Screven       | 702     |
| 431 | Senoia        | 1738    |
| 432 | Shady Dale    | 242     |
| 433 | Sharon        | 105     |

|     | CITY           | TOTAL  |
|-----|----------------|--------|
| 434 | Sharpsburg     | 316    |
| 435 | Shellman       | 1166   |
| 436 | Shiloh         | 423    |
| 437 | Siloam         | 331    |
| 438 | Sky Valley     | 221    |
| 439 | Smithville     | 774    |
| 440 | Smyrna         | 40,999 |
| 441 | Snellville     | 15,351 |
| 442 | Social Circle  | 3379   |
| 443 | Soperton       | 2824   |
| 444 | Sparks         | 1755   |
| 445 | Sparta         | 1522   |
| 446 | Springfield    | 1821   |
| 447 | Stapleton      | 318    |
| 448 | Statesboro     | 22,698 |
| 449 | Statham        | 2040   |
| 450 | Stillmore      | 730    |
| 451 | Stockbridge    | 9853   |
| 452 | Stone Mountain | 7145   |
| 453 | Sugar Hill     | 11,399 |
| 454 | Summertown     | 140    |
| 455 | Summerville    | 4556   |
| 456 | Sumner         | 309    |
| 457 | Sunny Side     | 142    |
| 458 | Surrency       | 237    |
| 459 | Suwanee        | 8725   |
| 460 | Swainsboro     | 6943   |
| 461 | Sycamore       | 496    |
| 462 | Sylvania       | 2675   |
| 463 | Sylvester      | 5990   |
| 464 | Talbotton      | 1019   |
| 465 | Talking Rock   | 49     |
| 466 | Tallapoosa     | 2789   |
| 467 | Tallah Falls   | 164    |
| 468 | Talmo          | 477    |

|     | CITY         | TOTAL  |
|-----|--------------|--------|
| 469 | Tarrytown    | 100    |
| 470 | Taylorsville | 229    |
| 471 | Temple       | 2383   |
| 472 | Tennille     | 1505   |
| 473 | Thomaston    | 9411   |
| 474 | Thomasville  | 18,162 |
| 475 | Thomson      | 6828   |
| 476 | Thunderbolt  | 2340   |
| 477 | Tifton       | 15,060 |
| 478 | Tiger        | 316    |
| 479 | Tignall      | 653    |
| 480 | Toccoa       | 9323   |
| 481 | Toombsboro   | 622    |
| 482 | Trenton      | 1942   |
| 483 | Trion        | 1993   |
| 484 | Tunnel Hill  | 1209   |
| 485 | Turin        | 165    |
| 486 | Twin City    | 1752   |
| 487 | Tybee Island | 3392   |
| 488 | Tyrone       | 3916   |
| 489 | Ty Ty        | 716    |
| 490 | Unadilla     | 2772   |
| 491 | Union City   | 11,621 |
| 492 | Union Point  | 1669   |
| 493 | Uvalda       | 530    |
| 494 | Valdosta     | 43,724 |
| 495 | Varnell      | 1491   |
| 496 | Vernonburgn  | 138    |
| 497 | Vidalia      | 10,491 |
| 498 | Vidette      | 112    |
| 499 | Vienna       | 2973   |
| 500 | Villa Rica   | 4134   |
| 501 | Waco         | 469    |
| 502 | Wadley       | 2088   |
| 503 | Waleska      | 616    |

|     | CITY          | TOTAL  |
|-----|---------------|--------|
| 504 | Walnut Grove  | 1241   |
| 505 | Walthourville | 4030   |
| 506 | Warm Springs  | 485    |
| 507 | Warner Robins | 48,804 |
| 508 | Warrenton     | 2013   |
| 509 | Warwick       | 430    |
| 510 | Washington    | 4295   |
| 511 | Watkinsville  | 2097   |
| 512 | Waverly Hall  | 709    |
| 513 | Waycross      | 15,333 |
| 514 | Waynesboro    | 5813   |
| 515 | Weston        | 75     |
| 516 | West Point    | 3382   |
| 517 | Whigham       | 631    |
| 518 | White         | 693    |
| 519 | White Plains  | 283    |
| 520 | Whitesburg    | 596    |
| 521 | Willacoochee  | 1434   |
| 522 | Williamson    | 297    |
| 523 | Winder        | 10,201 |
| 524 | Winterville   | 1068   |
| 525 | Woodbine      | 1218   |
| 526 | Woodbury      | 1184   |
| 527 | Woodland      | 432    |
| 528 | Woodstock     | 10,050 |
| 529 | Woodville     | 400    |
| 530 | Woolsey       | 175    |
| 531 | Wrens         | 2314   |
| 532 | Wrightsville  | 2223   |
| 533 | Yatesville    | 408    |
| 534 | Young Harris  | 604    |
| 535 | Zebulon       | 1181   |

# 8.3 Let's Compare!

## Population and Sample Means

### Objectives

In this lesson you will:

- Create samples of population data.
- Calculate sample means.
- Characterize populations using random samples.

### Key Terms

- outlier
- random sample
- random number



## Problem 1 Too Big!

1. Look up the population of the following cities using the population table at the end of the last lesson. Enter each population in the table shown.

| City/Town        | Population |
|------------------|------------|
| Macon            |            |
| Athens-Clarke    |            |
| Savannah         |            |
| Columbus         |            |
| Augusta-Richmond |            |
| Atlanta          |            |

2. Is the sample consisting of these five cities representative of the population data? Explain.
3. What is the effect of including one of these cities in the mean?  
The median?



An **outlier** is a data value that is significantly larger or smaller than the rest of the data values. Sometimes it is useful to avoid including outliers in a sample so that the sample better represents the data set.

- Does the population data set include any outliers that are smaller than the rest of the data values? Explain.

## Problem 2 How to Choose?



As a group, decide on some criterion for choosing a sample from the population data.

- Describe the criterion you used.
- Choose a sample of ten cities or towns using the criterion. List those cities and their populations in the table.

| City/Town | Population |
|-----------|------------|
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |
|           |            |

- Calculate the mean of your sample.

4. Collect the means of several other samples. List the means in the table from smallest to largest.

| Sample Number | Mean | Sample Number | Mean | Sample Number | Mean |
|---------------|------|---------------|------|---------------|------|
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |

5. Calculate the mean and median of the sample means from Question 4.
6. The mean of the entire population data set is 5952. How does the mean of your sample compare to the mean of the entire data set?
7. How does the mean of the sample means compare to the mean of the entire data set?



## Problem 3 Random Samples

8



It is difficult to choose a sample that is representative of the data set by picking data values by hand. A common alternative is a **random sample**. A random sample is a sample that is created by selecting data values randomly. When creating a random sample, each data value has an equal likelihood of being selected.

1. What is the probability of choosing each city in the population data set?
2. What is one method that you could use to create a random sample?



A **random number** is a number that is generated at random. Generating random numbers has been difficult historically. Now, technology such as a graphing calculator can be used to generate random numbers.

3. On a graphing calculator press the MATH key. Choose PRB and 1:rand. Press ENTER. This generates a random number between 0 and 1. Generate 10 random numbers between 0 and 1 and enter each in the first column of the table to four decimal places of accuracy.

| Random Number<br>Between 0 and 1 | Random Number<br>Between 1 and 535 | City | Population |
|----------------------------------|------------------------------------|------|------------|
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |
|                                  |                                    |      |            |

4. To generate random numbers between 1 and 535, multiply each random number between 0 and 1 by 535 and round to the nearest whole number. Enter the random numbers between 1 and 535 in the second column of the table from Question 3.



5. Look up each random number between 1 and 535 in the population data table. Enter the corresponding city and population in the third and fourth columns of the table from Question 3.
6. Calculate the mean of your random sample.
7. Collect the means of several other random samples. List the means in the table from smallest to largest.

| Sample Number | Mean | Sample Number | Mean | Sample Number | Mean |
|---------------|------|---------------|------|---------------|------|
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |
|               |      |               |      |               |      |

8. Calculate the mean and median of the sample means from Question 7.
9. The mean of the entire population data set is 5952. How does the mean of your random sample compare to the mean of the entire data set?
10. How does the mean of the sample means compare to the mean of the entire data set?



Be prepared to share your methods and solutions with the class.



# 8.4 An Experiment of Your Own

## Collecting and Analyzing Sample Data

### Objectives

In this lesson, you will:

- Collect and analyze sample data.
- Use sample data to make predictions and generalizations about population data.

### Problem 1 Your Sample

As a class, choose some data that you would like to explore. Data might include ages of people in your town, heights of students at your school, and so on.

1. Collect ten data points. Enter each in the table shown.

| Sample Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------|---|---|---|---|---|---|---|---|---|----|
| Data Value    |   |   |   |   |   |   |   |   |   |    |

2. Calculate the mean of your sample.
3. Based only on your sample and the sample mean, what can you predict about the population from which the sample was taken?





## Problem 2 The Group Sample

8

1. Form groups of four students. Enter your sample and the samples of the other students of your group in the table shown. This is your group sample.

| Sample Number | Data Value | Sample Number | Data Value | Sample Number | Data Value | Sample Number | Data Value |
|---------------|------------|---------------|------------|---------------|------------|---------------|------------|
| 1             |            | 11            |            | 21            |            | 31            |            |
| 2             |            | 12            |            | 22            |            | 32            |            |
| 3             |            | 13            |            | 23            |            | 33            |            |
| 4             |            | 14            |            | 24            |            | 34            |            |
| 5             |            | 15            |            | 25            |            | 35            |            |
| 6             |            | 16            |            | 26            |            | 36            |            |
| 7             |            | 17            |            | 27            |            | 37            |            |
| 8             |            | 18            |            | 28            |            | 38            |            |
| 9             |            | 19            |            | 29            |            | 39            |            |
| 10            |            | 20            |            | 30            |            | 40            |            |

2. Calculate the mean of your group sample.
3. Based only on your group sample and the sample mean, what can you predict about the population from which the sample was taken?





## Problem 3 The Class Sample

Collect the samples of every student in your class. Number the data values starting at 1. This is the class sample.



1. Calculate the mean of the class sample.
2. How does the mean of the class sample compare to the mean of your sample? To your group sample?
3. Based only on the class sample and the sample mean, what can you predict about the population from which the sample was taken?



## Problem 4 The Random Sample

1. Using the class sample and a random number generator to create a random sample of ten data values. Enter each in the table shown.

|                      |  |  |  |  |  |  |  |  |  |  |
|----------------------|--|--|--|--|--|--|--|--|--|--|
| <b>Random Number</b> |  |  |  |  |  |  |  |  |  |  |
| <b>Data Value</b>    |  |  |  |  |  |  |  |  |  |  |

2. Calculate the mean of the random sample.

3. How does the mean of the random sample compare to the mean of your sample? To your group sample? To the class sample?
4. Based only on the random sample and the sample mean, what can you predict about the population from which the sample was taken?
5. Examine your sample, your group sample, the class sample, and the random sample. Which sample provides the best information about the population that you are analyzing? Explain.



Be prepared to share your methods and solutions with the class.