

## 2.E: Graphs (Optional Exercises)

### 2.2: Stem-and-Leaf Graphs (Stemplots), Line Graphs, and Bar Graphs

#### Q 2.2.1

Student grades on a chemistry exam were: 77, 78, 76, 81, 86, 51, 79, 82, 84, 99

- Construct a stem-and-leaf plot of the data.
- Are there any potential outliers? If so, which scores are they? Why do you consider them outliers?

#### Q 2.2.2

Table contains the 2010 obesity rates in U.S. states and Washington, DC.

State	Percent (%)	State	Percent (%)	State	Percent (%)
Alabama	32.2	Kentucky	31.3	North Dakota	27.2
Alaska	24.5	Louisiana	31.0	Ohio	29.2
Arizona	24.3	Maine	26.8	Oklahoma	30.4
Arkansas	30.1	Maryland	27.1	Oregon	26.8
California	24.0	Massachusetts	23.0	Pennsylvania	28.6
Colorado	21.0	Michigan	30.9	Rhode Island	25.5
Connecticut	22.5	Minnesota	24.8	South Carolina	31.5
Delaware	28.0	Mississippi	34.0	South Dakota	27.3
Washington, DC	22.2	Missouri	30.5	Tennessee	30.8
Florida	26.6	Montana	23.0	Texas	31.0
Georgia	29.6	Nebraska	26.9	Utah	22.5
Hawaii	22.7	Nevada	22.4	Vermont	23.2
Idaho	26.5	New Hampshire	25.0	Virginia	26.0
Illinois	28.2	New Jersey	23.8	Washington	25.5
Indiana	29.6	New Mexico	25.1	West Virginia	32.5
Iowa	28.4	New York	23.9	Wisconsin	26.3
Kansas	29.4	North Carolina	27.8	Wyoming	25.1

- Use a random number generator to randomly pick eight states. Construct a bar graph of the obesity rates of those eight states.
- Construct a bar graph for all the states beginning with the letter "A."
- Construct a bar graph for all the states beginning with the letter "M."

#### S 2.2.2

- Example solution for using the random number generator for the TI-84+ to generate a simple random sample of 8 states. Instructions are as follows.
  - Number the entries in the table 1–51 (Includes Washington, DC; Numbered vertically)
  - Press MATH
  - Arrow over to PRB
  - Press 5:randInt(
  - Enter 51,1,8)

Eight numbers are generated (use the right arrow key to scroll through the numbers). The numbers correspond to the numbered states (for this example: {47 21 9 23 51 13 25 4}). If any numbers are repeated, generate a different number by using 5:randInt(51,1)). Here, the states (and Washington DC) are {Arkansas, Washington DC, Idaho, Maryland, Michigan, Mississippi, Virginia, Wyoming}.

Corresponding percents are {30.1, 22.2, 26.5, 27.1, 30.9, 34.0, 26.0, 25.1}.

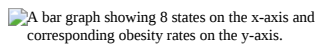
 A bar graph showing 8 states on the x-axis and corresponding obesity rates on the y-axis.

Figure 2.2.1 (a)

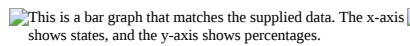
 This is a bar graph that matches the supplied data. The x-axis shows states, and the y-axis shows percentages.

Figure 2.2.2 (b)

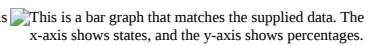
 This is a bar graph that matches the supplied data. The x-axis shows states, and the y-axis shows percentages.

Figure 2.2.2 (c)

For each of the following data sets, create a stem plot and identify any outliers.

### Exercise 2.2.7

The miles per gallon rating for 30 cars are shown below (lowest to highest).

19, 19, 19, 20, 21, 21, 25, 25, 25, 26, 26, 28, 29, 31, 31, 32, 32, 33, 34, 35, 36, 37, 37, 38, 38, 38, 38, 41, 43, 43

**Answer**

Stem	Leaf
1	9 9 9
2	0 1 1 5 5 5 6 6 8 9
3	1 1 2 2 3 4 5 6 7 7 8 8 8 8
4	1 3 3

The height in feet of 25 trees is shown below (lowest to highest).

25, 27, 33, 34, 34, 34, 35, 37, 37, 38, 39, 39, 39, 40, 41, 45, 46, 47, 49, 50, 50, 53, 53, 54, 54

The data are the prices of different laptops at an electronics store. Round each value to the nearest ten.

249, 249, 260, 265, 265, 280, 299, 299, 309, 319, 325, 326, 350, 350, 350, 365, 369, 389, 409, 459, 489, 559, 569, 570, 610

**Answer**

Stem	Leaf
2	5 5 6 7 7 8
3	0 0 1 2 3 3 5 5 5 7 7 9
4	1 6 9
5	6 7 7
6	1

The data are daily high temperatures in a town for one month.

61, 61, 62, 64, 66, 67, 67, 67, 68, 69, 70, 70, 70, 71, 71, 72, 74, 74, 74, 75, 75, 75, 76, 76, 77, 78, 78, 79, 79, 95

For the next three exercises, use the data to construct a line graph.

### Exercise 2.2.8

In a survey, 40 people were asked how many times they visited a store before making a major purchase. The results are shown in [Table](#).

Number of times in store	Frequency
1	4

Number of times in store	Frequency
2	10
3	16
4	6
5	4

### Answer


 This is a line graph that matches the supplied data. The x-axis shows the number of times people reported visiting a store before making a major purchase, and the y-axis shows the frequency.

Figure 2.2.7

### Exercise 2.2.9

In a survey, several people were asked how many years it has been since they purchased a mattress. The results are shown in [Table](#).

Years since last purchase	Frequency
0	2
1	8
2	13
3	22
4	16
5	9

### Exercise 2.2.10

Several children were asked how many TV shows they watch each day. The results of the survey are shown in [Table](#).

Number of TV Shows	Frequency
0	12
1	18
2	36
3	7
4	2

### Answer


 This is a line graph that matches the supplied data. The x-axis shows the number of TV shows a kid watches each day, and the y-axis shows the frequency.

Figure 2.2.8

### Exercise 2.2.11

The students in Ms. Ramirez's math class have birthdays in each of the four seasons. [Table](#) shows the four seasons, the number of students who have birthdays in each season, and the percentage (%) of students in each group. Construct a bar graph showing the number of students.

Seasons	Number of students	Proportion of population
Spring	8	24%
Summer	9	26%
Autumn	11	32%
Winter	6	18%

Using the data from Mrs. Ramirez's math class supplied in [Exercise](#), construct a bar graph showing the percentages.

**Answer**

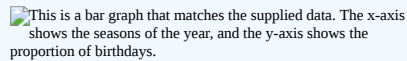
 This is a bar graph that matches the supplied data. The x-axis shows the seasons of the year, and the y-axis shows the proportion of birthdays.

Figure 2.2.9

### Exercise 2.2.12

David County has six high schools. Each school sent students to participate in a county-wide science competition. [Table](#) shows the percentage breakdown of competitors from each school, and the percentage of the entire student population of the county that goes to each school. Construct a bar graph that shows the population percentage of competitors from each school.

High School	Science competition population	Overall student population
Alabaster	28.9%	8.6%
Concordia	7.6%	23.2%
Genoa	12.1%	15.0%
Mocksville	18.5%	14.3%
Tynneson	24.2%	10.1%
West End	8.7%	28.8%

Use the data from the David County science competition supplied in [Exercise](#). Construct a bar graph that shows the county-wide population percentage of students at each school.

**Answer**

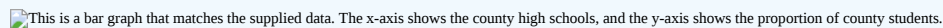
 This is a bar graph that matches the supplied data. The x-axis shows the county high schools, and the y-axis shows the proportion of county students.

Figure 2.2.10

## 2.3: Histograms, Frequency, Polygons, and Time Series Graphs

### Q 2.3.1

Suppose that three book publishers were interested in the number of fiction paperbacks adult consumers purchase per month. Each publisher conducted a survey. In the survey, adult consumers were asked the number of fiction paperbacks they had purchased the previous month. The results are as follows:

Publisher A

# of books	Freq.	Rel. Freq.
0	10	
1	12	
2	16	
3	12	

# of books	Freq.	Rel. Freq.
4	8	
5	6	
6	2	
8	2	

Publisher B

# of books	Freq.	Rel. Freq.
0	18	
1	24	
2	24	
3	22	
4	15	
5	10	
7	5	
9	1	

Publisher C

# of books	Freq.	Rel. Freq.
0–1	20	
2–3	35	
4–5	12	
6–7	2	
8–9	1	

- Find the relative frequencies for each survey. Write them in the charts.
- Using either a graphing calculator, computer, or by hand, use the frequency column to construct a histogram for each publisher's survey. For Publishers A and B, make bar widths of one. For Publisher C, make bar widths of two.
- In complete sentences, give two reasons why the graphs for Publishers A and B are not identical.
- Would you have expected the graph for Publisher C to look like the other two graphs? Why or why not?
- Make new histograms for Publisher A and Publisher B. This time, make bar widths of two.
- Now, compare the graph for Publisher C to the new graphs for Publishers A and B. Are the graphs more similar or more different? Explain your answer.

### Q 2.3.2

Often, cruise ships conduct all on-board transactions, with the exception of gambling, on a cashless basis. At the end of the cruise, guests pay one bill that covers all onboard transactions. Suppose that 60 single travelers and 70 couples were surveyed as to their on-board bills for a seven-day cruise from Los Angeles to the Mexican Riviera. Following is a summary of the bills for each group.

Singles

Amount(\$)	Frequency	Rel. Frequency
51–100	5	

Amount(\$)	Frequency	Rel. Frequency
101–150	10	
151–200	15	
201–250	15	
251–300	10	
301–350	5	

Couples

Amount(\$)	Frequency	Rel. Frequency
100–150	5	
201–250	5	
251–300	5	
301–350	5	
351–400	10	
401–450	10	
451–500	10	
501–550	10	
551–600	5	
601–650	5	

- Fill in the relative frequency for each group.
- Construct a histogram for the singles group. Scale the x-axis by \$50 widths. Use relative frequency on the y-axis.
- Construct a histogram for the couples group. Scale the x-axis by \$50 widths. Use relative frequency on the y-axis.
- Compare the two graphs:
  - List two similarities between the graphs.
  - List two differences between the graphs.
  - Overall, are the graphs more similar or different?
- Construct a new graph for the couples by hand. Since each couple is paying for two individuals, instead of scaling the x-axis by \$50, scale it by \$100. Use relative frequency on the y-axis.
- Compare the graph for the singles with the new graph for the couples:
  - List two similarities between the graphs.
  - Overall, are the graphs more similar or different?
- How did scaling the couples graph differently change the way you compared it to the singles graph?
- Based on the graphs, do you think that individuals spend the same amount, more or less, as singles as they do person by person as a couple? Explain why in one or two complete sentences.

### S 2.3.2

Singles

Amount(\$)	Frequency	Relative Frequency
51–100	5	0.08
101–150	10	0.17
151–200	15	0.25

Amount(\$)	Frequency	Relative Frequency
201–250	15	0.25
251–300	10	0.17
301–350	5	0.08

Couples

Amount(\$)	Frequency	Relative Frequency
100–150	5	0.07
201–250	5	0.07
251–300	5	0.07
301–350	5	0.07
351–400	10	0.14
401–450	10	0.14
451–500	10	0.14
501–550	10	0.14
551–600	5	0.07
601–650	5	0.07

a. See [Table](#) and [Table](#).

b. In the following histogram data values that fall on the right boundary are counted in the class interval, while values that fall on the left boundary are not counted (with the exception of the first interval where both boundary values are included).

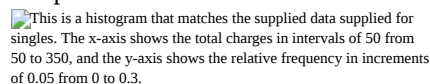
 This is a histogram that matches the supplied data supplied for singles. The x-axis shows the total charges in intervals of 50 from 50 to 350, and the y-axis shows the relative frequency in increments of 0.05 from 0 to 0.3.

Figure 2.3.2.1.

c. In the following histogram, the data values that fall on the right boundary are counted in the class interval, while values that fall on the left boundary are not counted (with the exception of the first interval where values on both boundaries are included).

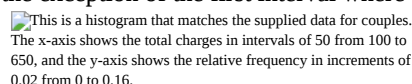
 This is a histogram that matches the supplied data for couples. The x-axis shows the total charges in intervals of 50 from 100 to 650, and the y-axis shows the relative frequency in increments of 0.02 from 0 to 0.16.

Figure 2.3.2.2.

d. Compare the two graphs:

i. Answers may vary. Possible answers include:

- Both graphs have a single peak.
- Both graphs use class intervals with width equal to \$50.

ii. Answers may vary. Possible answers include:

- The couples graph has a class interval with no values.
- It takes almost twice as many class intervals to display the data for couples.

iii. Answers may vary. Possible answers include: The graphs are more similar than different because the overall patterns for the graphs are the same.

e. Check student's solution.

f. Compare the graph for the Singles with the new graph for the Couples:

- i. ■ Both graphs have a single peak.
- Both graphs display 6 class intervals.

- Both graphs show the same general pattern.
- ii. Answers may vary. Possible answers include: Although the width of the class intervals for couples is double that of the class intervals for singles, the graphs are more similar than they are different.
- g. Answers may vary. Possible answers include: You are able to compare the graphs interval by interval. It is easier to compare the overall patterns with the new scale on the Couples graph. Because a couple represents two individuals, the new scale leads to a more accurate comparison.
- h. Answers may vary. Possible answers include: Based on the histograms, it seems that spending does not vary much from singles to individuals who are part of a couple. The overall patterns are the same. The range of spending for couples is approximately double the range for individuals.

### Q 2.3.3

Twenty-five randomly selected students were asked the number of movies they watched the previous week. The results are as follows.

# of movies	Frequency	Relative Frequency	Cumulative Relative Frequency
0	5		
1	9		
2	6		
3	4		
4	1		

- a. Construct a histogram of the data.
- b. Complete the columns of the chart.

Use the following information to answer the next two exercises: Suppose one hundred eleven people who shopped in a special t-shirt store were asked the number of t-shirts they own costing more than \$19 each.

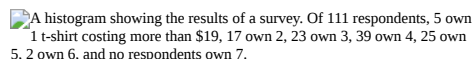
A histogram showing the results of a survey. Of 111 respondents, 5 own 1 t-shirt costing more than \$19, 17 own 2, 23 own 3, 39 own 4, 25 own 5, 2 own 6, and no respondents own 7.

Figure 2.3.3.1.

### Q 2.3.4

The percentage of people who own at most three t-shirts costing more than \$19 each is approximately:

- a. 21
- b. 59
- c. 41
- d. Cannot be determined

### S 2.3.4

c

### Q 2.3.5

If the data were collected by asking the first 111 people who entered the store, then the type of sampling is:

- a. cluster
- b. simple random
- c. stratified
- d. convenience



### Q 2.3.6

Following are the 2010 obesity rates by U.S. states and Washington, DC.

State	Percent (%)	State	Percent (%)	State	Percent (%)
Alabama	32.2	Kentucky	31.3	North Dakota	27.2
Alaska	24.5	Louisiana	31.0	Ohio	29.2
Arizona	24.3	Maine	26.8	Oklahoma	30.4
Arkansas	30.1	Maryland	27.1	Oregon	26.8
California	24.0	Massachusetts	23.0	Pennsylvania	28.6
Colorado	21.0	Michigan	30.9	Rhode Island	25.5
Connecticut	22.5	Minnesota	24.8	South Carolina	31.5
Delaware	28.0	Mississippi	34.0	South Dakota	27.3
Washington, DC	22.2	Missouri	30.5	Tennessee	30.8
Florida	26.6	Montana	23.0	Texas	31.0
Georgia	29.6	Nebraska	26.9	Utah	22.5
Hawaii	22.7	Nevada	22.4	Vermont	23.2
Idaho	26.5	New Hampshire	25.0	Virginia	26.0
Illinois	28.2	New Jersey	23.8	Washington	25.5
Indiana	29.6	New Mexico	25.1	West Virginia	32.5
Iowa	28.4	New York	23.9	Wisconsin	26.3
Kansas	29.4	North Carolina	27.8	Wyoming	25.1

Construct a bar graph of obesity rates of your state and the four states closest to your state. Hint: Label the  $x$ -axis with the states.

### S 2.3.7

Answers will vary.

#### Exercise 2.3.6

Sixty-five randomly selected car salespersons were asked the number of cars they generally sell in one week. Fourteen people answered that they generally sell three cars; nineteen generally sell four cars; twelve generally sell five cars; nine generally sell six cars; eleven generally sell seven cars. Complete the table.

Data Value (# cars)	Frequency	Relative Frequency	Cumulative Relative Frequency

#### Exercise 2.3.7

What does the frequency column in Table sum to? Why?

**Answer**

65

#### Exercise 2.3.8

What does the relative frequency column in Table sum to? Why?

### Exercise 2.3.9

What is the difference between relative frequency and frequency for each data value in Table?

#### Answer

The relative frequency shows the *proportion* of data points that have each value. The frequency tells the *number* of data points that have each value.

### Exercise 2.3.10

What is the difference between cumulative relative frequency and relative frequency for each data value?

### Exercise 2.3.11

To construct the histogram for the data in Table, determine appropriate minimum and maximum  $x$  and  $y$  values and the scaling. Sketch the histogram. Label the horizontal and vertical axes with words. Include numerical scaling.


 An empty graph template for use with this question.

Figure 2.3.9.

#### Answer

Answers will vary. One possible histogram is shown:

Figure 2.3.10.

### Exercise 2.3.12

Construct a frequency polygon for the following:

a.	Pulse Rates for Women	Frequency
	60–69	12
	70–79	14
	80–89	11
	90–99	1
	100–109	1
	110–119	0
	120–129	1

b.	Actual Speed in a 30 MPH Zone	Frequency
	42–45	25
	46–49	14
	50–53	7
	54–57	3
	58–61	1

c.	Tar (mg) in Nonfiltered Cigarettes	Frequency
	10–13	1
	14–17	0

Tar (mg) in Nonfiltered Cigarettes	Frequency
18–21	15
22–25	7
26–29	2

### Exercise 2.3.13

Construct a frequency polygon from the frequency distribution for the 50 highest ranked countries for depth of hunger.

Depth of Hunger	Frequency
230–259	21
260–289	13
290–319	5
320–349	7
350–379	1
380–409	1
410–439	1

### Answer

Find the midpoint for each class. These will be graphed on the x-axis. The frequency values will be graphed on the y-axis values.

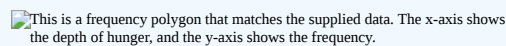
 This is a frequency polygon that matches the supplied data. The x-axis shows the depth of hunger, and the y-axis shows the frequency.

Figure 2.3.11.

### Exercise 2.3.14

Use the two frequency tables to compare the life expectancy of men and women from 20 randomly selected countries. Include an overlaid frequency polygon and discuss the shapes of the distributions, the center, the spread, and any outliers. What can we conclude about the life expectancy of women compared to men?

Life Expectancy at Birth – Women	Frequency
49–55	3
56–62	3
63–69	1
70–76	3
77–83	8
84–90	2

Life Expectancy at Birth – Men	Frequency
49–55	3
56–62	3
63–69	1

Life Expectancy at Birth – Men	Frequency
70–76	1
77–83	7
84–90	5

### Exercise 2.3.15

Construct a times series graph for (a) the number of male births, (b) the number of female births, and (c) the total number of births.

Sex/Year	1855	1856	1857	1858	1859	1860	1861
Female	45,545	49,582	50,257	50,324	51,915	51,220	52,403
Male	47,804	52,239	53,158	53,694	54,628	54,409	54,606
Total	93,349	101,821	103,415	104,018	106,543	105,629	107,009

Sex/Year	1862	1863	1864	1865	1866	1867	1868	1869
Female	51,812	53,115	54,959	54,850	55,307	55,527	56,292	55,033
Male	55,257	56,226	57,374	58,220	58,360	58,517	59,222	58,321
Total	107,069	109,341	112,333	113,070	113,667	114,044	115,514	113,354

Sex/Year	1871	1870	1872	1871	1872	1827	1874	1875
Female	56,099	56,431	57,472	56,099	57,472	58,233	60,109	60,146
Male	60,029	58,959	61,293	60,029	61,293	61,467	63,602	63,432
Total	116,128	115,390	118,765	116,128	118,765	119,700	123,711	123,578

**Answer**

Figure 2.3.12.

### Exercise 2.3.16

The following data sets list full time police per 100,000 citizens along with homicides per 100,000 citizens for the city of Detroit, Michigan during the period from 1961 to 1973.

Year	1961	1962	1963	1964	1965	1966	1967
Police	260.35	269.8	272.04	272.96	272.51	261.34	268.89
Homicides	8.6	8.9	8.52	8.89	13.07	14.57	21.36

Year	1968	1969	1970	1971	1972	1973
Police	295.99	319.87	341.43	356.59	376.69	390.19
Homicides	28.03	31.49	37.39	46.26	47.24	52.33

- Construct a double time series graph using a common x-axis for both sets of data.
- Which variable increased the fastest? Explain.
- Did Detroit's increase in police officers have an impact on the murder rate? Explain.

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