

Chapter 12 **Parent Guide**
Discrete Mathematics: Statistics

Statistics are found in newspapers, professional journals, business reports, and financial reviews. Every business is dependent upon statistics, which helps people interpret business-related data.

Your child has been studying statistics in one form or another since the first year of school. Each year, your child has learned a new skill in statistics. Now, your child will take a closer look at graphs studied in previous years and also learn about measures of dispersion, binomial distributions, and normal distributions in graphs.

Lesson 12.1 discusses the relevance of mean, median, and mode of a set of data. Lesson 12.2 shows how to display and interpret data in a stem-and-leaf plot, histogram, and circle graph.

Lesson 12.3 shows how to represent data in a box-and-whisker plot. Lesson 12.4 calculates range, mean deviation, variance, and standard deviation. Lesson 12.5 explores probability of binomial experiments. Finally, Lesson 12.6 uses a normal distribution curve to discuss probability.

Statistics is a major branch of mathematics that your child may want to consider studying if he or she enjoys this chapter. College statistics goes into far more detail than outlined in this chapter. However, it does provide a foundation for further study.

The following discussion on stem-and-leaf plots will help your child see a connection between this type of display and histograms or bar graphs.

PROBLEM FOR DISCUSSION (See textbook page 772)

An Internet site recorded the number of “hits” between 4 P.M. and 6 P.M. on 28 randomly selected weekdays. The results are listed in the table on page 772. In what ways can you represent this data?

1. Discuss how the stem-and-leaf plot is made from the data in the table.

In a stem-and-leaf plot, each data value in the table is split into two parts: a stem and a leaf.

In this table of data, the stem is the tens digit in the number and the leaf is the remaining units digit.

For example, for the number 73, the stem is 7 and the leaf is 3. For a one-digit number, like 6, the stem is 0 and the leaf is 5.

2. Describe the structure of the stem-and-leaf plot. Discuss how it resembles a table and how it differs from a traditional table. What are the advantages of using a stem-and-leaf plot instead of a table?

In a stem-and-leaf plot, the stems are listed vertically and their corresponding leaves are listed next to them in a different column.

This table is different from a traditional table because there is more than one number in a given row/column. For instance, for the stem 4 in the table on page 772, there are 4 leaves, 1, 2, 2, and 5.

The advantages to using stem-and-leaf plots are that you can easily see the maximum and minimum of the data, you can see if the data is evenly distributed, and you can determine the mean, median, and mode.

3. Discuss whether this data would be better represented in a histogram or in a circle graph.

A histogram and a circle graph are both methods that can help you to see data patterns more clearly. In this case, a circle graph would not be a good way to see any patterns because a circle graph only shows relationships related to the whole. Also, you cannot determine the mean, median, and mode from a circle graph.

A histogram may be better to use than a circle graph, but it still is not an effective way to see any relationships or patterns because very few of the numbers in this particular data set were used more than once.

4. Discuss how the stem-and-leaf plot compares to a histogram.

Each type of display is an effective way to display the frequency of a data set of values. The histogram, however, gives more of a visual display, like a bar graph.

5. Discuss how you can use the stem-and-leaf plot to find the median (middle number) in the data set. Discuss how you could determine the mode.

First, look at the number of values in the entire data set.

There are 28 numbers in this data set.

The median is the middle number of the data set.

The number in the middle is the mean of the 14th and the 15th number.

This is because there is an even number of elements in the data set.

The mean of the 14th and 15th numbers, 38 and 41, is 39.5. So the median is 39.5.

To determine the mode, the value that is repeated the most often, look at each stem and see how many of its leaves repeat. The only stems that have repeating leaves are 1 and 4. So 19 and 42 are the modes because they both occur twice.

6. Explain why a table would be easier to use than a stem-and-leaf plot for finding the mean.

A table would be easier to find the mean because the numbers would not be split into their digits. To find the mean you add up all the

numbers and then divide by the number of numbers. This is difficult to do when the numbers have been split.

The following are complete worked out solutions to selected exercises in the student textbook. These solutions are provided to you so that you can help your child with their homework. Your child's classroom notes, example problems in the text, and these worked out solutions are all useful tools to help you and your child work through their assignment.

Lesson 12.1

11. $\bar{x} = \frac{14 + 16 + 19 + 14 + 12 + 15 + 13}{7}$
 $= \frac{103}{7} \approx 14.714$

Order the values: 12, 13, 14, 14, 15, 16, 19
 median = 14, the middle value
 mode = 14, the most often repeated value

23.

Number of pets	Frequency	Product
0	8	0
1	7	7
2	6	12
3	4	12
4	5	20
Total	30	51

$\bar{x} = \frac{51}{30} = 1.7$ pets

35. a. $\bar{x} = \frac{5 + 6 + 5\frac{1}{2} + 7 + 9 + 6 + 5 + 7\frac{1}{2} + 7 + 5 + 8 + 6\frac{1}{2} + 7 + 8 + 6 + 4 + 6\frac{1}{2} + 10 + 7}{19} = \frac{126}{19} \approx 6.632$

order the values: 4, 5, 5, 5, $5\frac{1}{2}$, 6, 6, 6, $6\frac{1}{2}$, $6\frac{1}{2}$, 7, 7, 7, 7, $7\frac{1}{2}$, 8, 8, 9, 10

median = $6\frac{1}{2}$, the middle value

mode = 7, the most often repeated value

The mean and median are similar, whereas the mode is a bit higher.

- b. The mode may be the most helpful for maintaining stock because the manager should stock the most of this size.

Lesson 12.2

11.

Stem	Leaf 33 5 = 335
33	5, 6, 7, 8, 9
34	0, 7, 7, 8, 8
35	6, 7, 8, 9

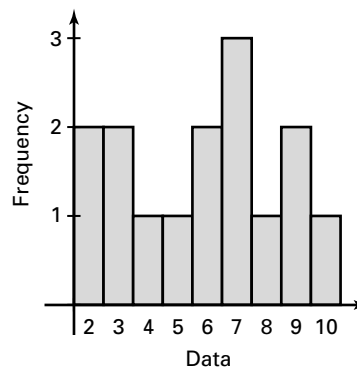
median = $\frac{347 + 347}{2} = 347$, the average of the 7th and 8th values.

modes = 347 and 348, since each occurs twice and the others occur once.

The distribution is even-shaped, since the values are fairly evenly distributed between 335 and 359.

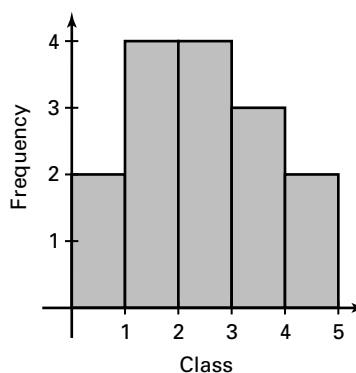
14.

Data	Frequency
2	2
3	2
4	1
5	1
6	2
7	3
8	1
9	2
10	1

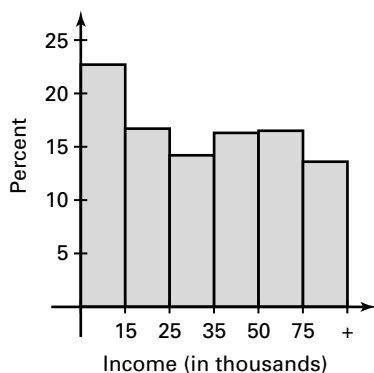


22.

Class	Frequency
$0 \leq x < 1$	2
$1 \leq x < 2$	4
$2 \leq x < 3$	4
$3 \leq x < 4$	3
$4 \leq x < 5$	2
$5 \leq x < 6$	0



27. a. A histogram will show the distribution best. It is easier to compare the heights of the bars than the sizes of the pie slices in a circle graph.



b. The distribution is uniform since the values are fairly evenly distributed.

c. Let event $A = \$50,000 - \$74,999$, and event $B = \text{over } \$75,000$. Events A and B are mutually exclusive, so $P(A \text{ or } B) = P(A) + P(B) = 16.5 + 13.6 = 30.1$.

The probability that a randomly selected household has an income of \$50,000 or more is 30.1%.

Lesson 12.3

9. Order the values:

102, 120, 125, 130, 130, 130, 154, 175, 180, 190

minimum = 102

$Q_1 = 125$

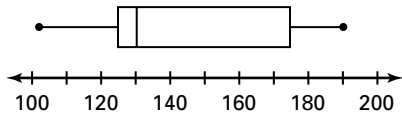
$Q_2 = 130$

$Q_3 = 175$

maximum = 190

range = $190 - 102 = 88$

IQR = $175 - 125 = 50$



18. Class 1 and Class 2 have equal Q_1 and they are higher than that of Class 3.

25. a. Order the data:

62, 64, 66, 70, 71, 73, 73, 74, 75, 75, 76, 78, 78

minimum = 62

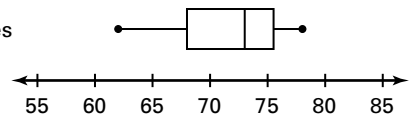
$Q_1 = \frac{66 + 70}{2} = 68$

$Q_2 = 73$

$Q_3 = \frac{75 + 76}{2} = 75.5$

maximum = 78

b. Both sexes



Lesson 12.4

7. $\bar{x} = \frac{1 + 2 + \dots + 6}{5} = 3$

x_i	$ x_i - 3 $
1	2
2	1
4	1
2	1
6	3
Total	8

range = $6 - 1 = 5$

mean deviation = $\frac{8}{5} = 1.6$

16. $\bar{x} = \frac{8.1 + \dots + 10.7}{5} = 8.46$

$\sigma^2 = \frac{1}{5}[(8.1 - 8.46)^2 + \dots + (10.7 - 8.46)^2] \approx 7.19$

$\sigma = \sqrt{7.1} \approx 2.68$

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$$23. \bar{x} = \frac{0 + 500 + 510 + 520}{4} = 382.5$$

$$\text{mean deviation} = \frac{1}{4}[|0 - 382.5| + \cdots + |520 - 382.5|] = 191.25$$

$$\text{standard deviation} = \sqrt{\frac{1}{4}[(0 - 382.5)^2 + \cdots + (520 - 382.5)^2]} \approx 220.95$$

The mean deviation is slightly less affected by an extreme value.

31. Location 1:

$$\text{range} = 13,890 - 11,723 = 2167$$

$$\bar{x} = \frac{12,375 + \cdots + 11,723}{12} = 12,528.25$$

$$\text{mean deviation} = \frac{1}{12}[|12,375 - 12,528.25| + \cdots + |11,723 - 12,528.25|] \approx 527.3$$

Location 2:

$$\text{range} = 13,543 - 11,728 = 1815$$

$$\bar{x} = \frac{13,245 + \cdots + 12,887}{12} = 12,733.25$$

$$\text{mean deviation} = \frac{1}{12}[|13,245 - 12,733.25| + \cdots + |12,887 - 12,733.25|] \approx 442.3$$

The sales at location 1 are more variable (less consistent) than those at location 2.

32. Location 1:

$$\sigma^2 = \frac{1}{12}[(12,375 - 12,528.25)^2 + \cdots + (11,723 - 12,528.25)^2] \approx 400,714.7$$

$$\sigma = \sqrt{400,714.7} \approx 633.02$$

Location 2:

$$\sigma^2 = \frac{1}{12}[(13,245 - 12,733.25)^2 + \cdots + (12,887 - 12,733.25)^2] \approx 292,018.2$$

$$\sigma = \sqrt{292,018.2} \approx 540.39$$

The sales at location 1 are more variable (less consistent) than those at location 2.

Lesson 12.5

$$10. {}_8C_6(0.5)^6(0.5)^2 \approx 0.109$$

$$16. {}_4C_4(0.5)^4(0.5)^0 = 0.0625$$

$$\begin{aligned} 28. P(\text{at least } 5) &= P(5) + P(6) + P(7) + P(8) + P(9) + P(10) \\ &= {}_{10}C_5(0.25)^5(0.75)^5 + {}_{10}C_6(0.25)^6(0.75)^4 + {}_{10}C_7(0.25)^7(0.75)^3 + {}_{10}C_8(0.25)^8(0.75)^2 \\ &\quad + {}_{10}C_9(0.25)^9(0.75)^1 + {}_{10}C_{10}(0.25)^{10}(0.75)^0 \\ &\approx 0.078 \end{aligned}$$

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$$\begin{aligned} 33. P(\text{at least } 3) &= P(3) + P(4) + P(5) \\ &= {}_5C_3(0.3)^3(0.7)^2 + {}_5C_4(0.3)^4(0.7)^1 \\ &\quad + {}_5C_5(0.3)^5(0.7)^0 \\ &\approx 0.163 \end{aligned}$$

$$41. P(\text{exactly } 5) = {}_{10}C_5(0.54)^5(0.46)^5 \approx 0.238$$

$$\begin{aligned} 44. P(\text{at least } 2) &= 1 - P(\text{at most } 1) = 1 - [P(0) + P(1)] \\ &= 1 - [{}_{10}C_0(0.4)^0(0.6)^{10} + {}_{10}C_1(0.4)^1(0.6)^9] \\ &\approx 1 - 0.046 \approx 0.954 \end{aligned}$$

Lesson 12.6

$$\begin{aligned} 9. P(x \geq 0.4) &= 0.5 - P(0 \leq x \leq 0.4) \\ &= 0.5 - 0.1554 = 0.3446 \end{aligned}$$

$$\begin{aligned} 24. P(0.842 \leq x \leq 1.233) &= 0.3912 - 0.3001 \\ &= 0.0911 \end{aligned}$$

$$\begin{aligned} 29. P(x < 28) &= P\left(z < \frac{28 - 40}{6}\right) \\ &= P(z < -2) \\ &= 0.5 - 0.4772 \\ &= 0.0228 \end{aligned}$$

$$\begin{aligned} 36. P(450 < x < 550) &= P\left(\frac{450 - 500}{50} < z < \frac{550 - 500}{50}\right) \\ &= P(-1 < z < 1) \\ &= 2(0.3413) \\ &= 0.6826 \\ 28,000(0.6826) &\approx 19,113 \text{ individuals} \end{aligned}$$

$$\begin{aligned} 47. P(x \leq 3) &= P\left(z \leq \frac{3 - 6.3}{2.3}\right) \\ &\approx P(z \leq -1.43) \\ &\approx 0.5 - 0.4236 \\ &= 0.0764 \end{aligned}$$