Teacher Notes: Exercise and Cholesterol Level

Overview: This classroom activity could be adapted for work in groups or individual project depending on the experience of the students. Through simulation, students investigate how likely, or unlikely, it is to obtain results similar to those presented in a hypothesized study. Multiple samples and measures are then collected using Fathom™ 2. Part I is designed to be done in groups of two or three. Part II can be done as a whole-class discussion. Part III is an extension activity that can be assigned individually.

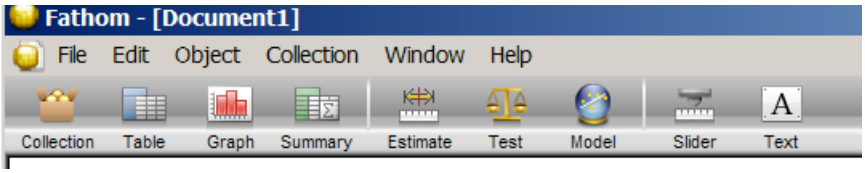
Student Page with Answers:
Part I:
Studies show that high cholesterol is a risk factor for heart disease. Table 1 lists data from a study investigating the effect of exercise on cholesterol levels. Twenty-four hospital employees voluntarily went to a gym to exercise for one hour per day, three times per week. The data show their cholesterol levels both before and after the four months of exercise, in milligrams of cholesterol per deciliter of blood (mg/dL). Suppose for the activities that it is always desirable to decrease the level of cholesterol in the blood. Thus, assume that the purpose of the exercise was to decrease that level.

Table 1: Cholesterol Levels of 24 employees before and after the four months of exercise

Before	**After**	**Before**	**After**
(mg/dL)	(mg/dL)	(mg/dL)	(mg/dL)
195	146	169	182
145	155	158	127
205	178	151	149
159	146	197	178
244	208	180	161
166	147	222	187
250	202	168	176
236	215	168	145
192	184	167	154
224	208	161	153
238	206	178	137
197	169	137	125

EXERCISE AND CHOLESTEROL

1. Drag a case table from the shelf as in Figure 1.



New Case Table

Figure 1

2. Enter data from the exercise sheet using **Before** and **After** as attributes as in Figure 2a.

3. Create a new attribute, **Difference,** by typing its name where you see the <new> column heading. Then press enter.

4. To create the formula for **Difference,** select the column and choose Edit>Edit Formula from the menu bar. The formula editor appears; enter **After – Before** and then press **OK** to close the editor as in Figure 2b.

Cholesterol Levels

	Before	After	<new>
=			
1	195	146	
2	145	155	
3	205	178	
4	159	146	
5	244	208	
6	166	147	

a.

Cholesterol Levels

	Before	After	Difference
=			
1	195	146	-49
2	145	155	10
3	205	178	-27
4	159	146	-13
5	244	208	-36
6	166	147	-19
7	250	202	-48
8	236	215	-21
9	192	184	-8

b.

Figure 2

a. In the context of the problem, what do the positive differences represent?
The positive values represent a gain of cholesterol.

b. What do the negative values represent?
The negative values represent a loss of cholesterol.

5. To create a dot plot of the difference, pull down a new graph from the shelf. Drag the name of the attribute **Difference** to the horizontal axis as in Figure 3.

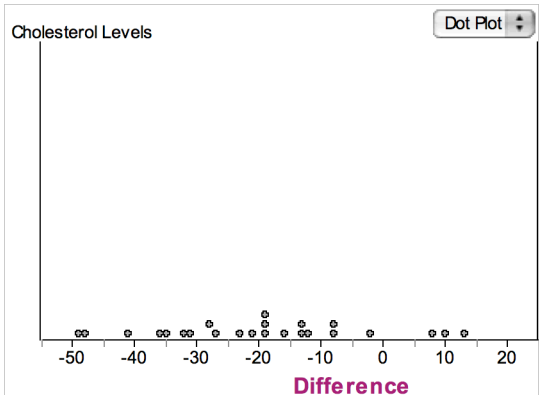


Figure 3

6. Drag a new graph off the shelf; drag the name of the attribute **Difference** to the horizontal axis. Change from Dot Plot to Histogram as in Figure 4.

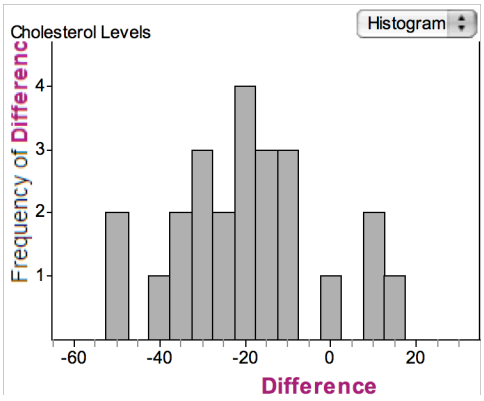


Figure 4

7. Drag a new graph off the shelf; drag the name of the attribute **Difference** to the horizontal axis. Change from Dot Plot to Box Plot as in Figure 5.

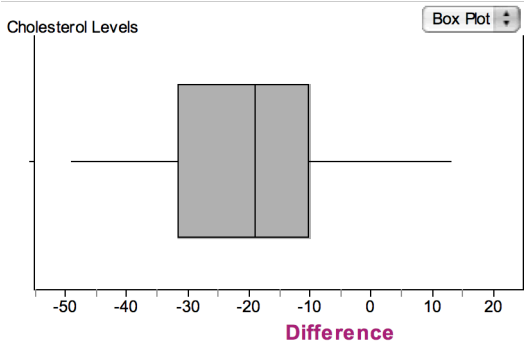


Figure 5

Part II.

Student Questions:

8. For each of the following, which graph would you choose to answer this question and why? *Answers may vary.*

   a. What are the minimum and maximum values? What do these values represent in this situation?

      Minimum and maximum values can be determined from the dot plot as it shows individual values. maximum 13, minimum -49. The maximum value represents a gain of 13 in cholesterol and the -49 value represents a loss of 49 in cholesterol.

   b. What is the spread?

      The spread is the range (max-min) which is 62 and is illustrated by the boxplot.

   c. What is the shape?

      The shape is approximately normal

   d. Estimate the percentage of volunteers who saw a decrease in their cholesterol level.

      There were 21 out of 24 or 21/24 subjects which is 87.5%.

   e. What is the shape of the distribution?

      A histogram and box plot both show that the distribution is roughly symmetric. According to the histogram, the data is approximately normal.

   f. What is the center?

      The center is the median which is -19.

Part III:

Fathom Simulation:

1. Drag a new case table from the shelf. Create a new attribute **Result**, choose the Edit>Edit Formula. The formula editor appears; enter **randompick("gain", "lose")**. Choose ok. Choose Collection>New Cases, 24**.** (See Figure 6.)

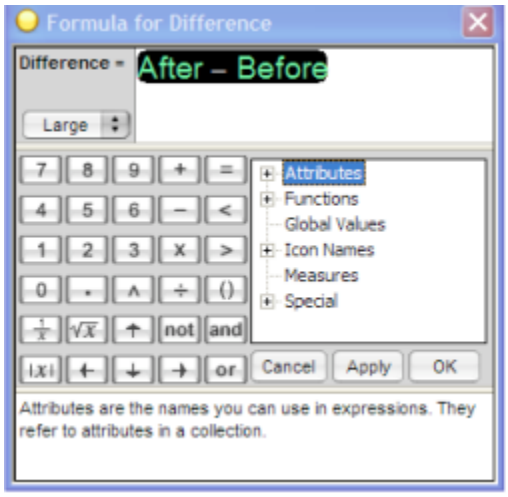
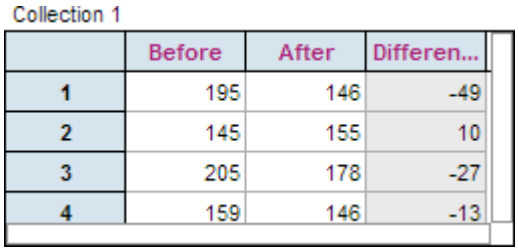


Figure 6

2. Expand the collection box to show individual cases. (See Figure 7.)



Collection 1

	Before	After	Differen...
1	195	146	-49
2	145	155	10
3	205	178	-27
4	159	146	-13

Figure 7

3. Drag a graph from the shelf. Drag **Result** to the horizontal axis. For this random sample, did most show an increase or decrease in cholesterol. Rerandomize cases. How did the results change? Repeat this process several times. (See Figure 8.)

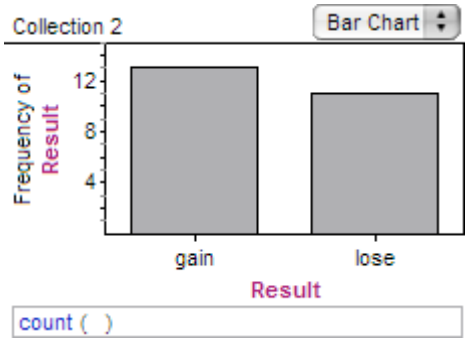


Figure 8

In this case, there were more gains than losses

4. Double click the collection to bring up the Inspector, choose measures and define a new measure **decrease**. Click on the 'Formula' cell for **decrease** and enter **count(result = "lose")**. Choose ok. This defines a measure that counts the number of volunteers who show a decrease in cholesterol. (See Figure 9.)

Collection 2

	Result	Decrease
=	randomPick ("gain", "lose")	count (Result = "lose"
1	gain	15
2	gain	15
3	lose	15
4	gain	15
5	lose	15

Figure 9

5. Expand the 'Measures from collection' box; there are five measures. With the collection selected, choose Collection>collect measures. In the Measures from Collection>, double click the first case, go to display. At 'Captions' edit the formula to show **Decrease**. This will display the number out of 24 who experienced a decrease in their cholesterol. (See Figure 10.)

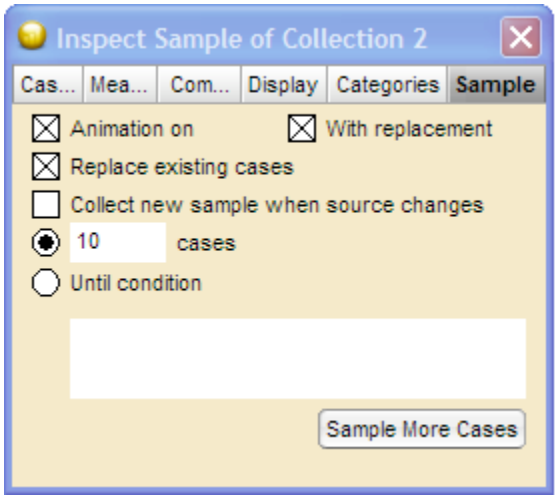


Figure 10

6. Click on 'collect more measures'. It will now show 10 counts. Of these 10, how many show a decrease in 21 or more volunteers?

Answers will vary according to simulation.

7. Double click the ‘measures from collection’ collect measures, animation off, replace existing cases, collect 100 measures. Of these 100, how many show a decrease in 21 or more volunteers?

   Answers will vary according to simulation.

8. Collect 1000 measures, how many show a decrease in 21 or more volunteers? What does this result tell you about the results of the study?

   Answers will vary according to simulation.
   These results tell us that the exercise may have shown an improvement, i.e. decreasing the level of cholesterol in blood because significantly more than half of the simulations showed a decrease in cholesterol levels.

9. Think about how the study was designed. How could you improve on the design to make the results more reliable?

   - *Choose random samples from a population other than hospital workers.*
   - *Have a control group.*
   - *Compare male and female subjects.*
   - *Other answers as appropriate*