Crime & Coffee #1 Rubric with Answers

Task adopted from www.illustrativemathmatics.org aligned with standard S-ID.B6

Written task aligned with LR: Loop 1

Grade each question below using the following three grades: Essentially Correct (E), Partially Correct (P), and Incorrect (I).

Example answers for each category are given below each question.

Once each of the questions is graded in this manner, the results will then be tallied to give an overall score for the task. For each E, a person will receive 1 point. For each P, a person will receive ½ point. For each I, a person will receive 0 points. The overall grade will be one of the following:

4   Complete Response

3/3.5   Substantial Response

2/2.5   Developing Response

1/1.5   Minimal Response

Please write the amount of points earned and the word to describe the points earned (complete, substantial, developing, or minimal) on the front page of each person's paper.

Crime & Coffee

Many counties in the United States are governed by a county council. At public county council meetings, county residents are usually allowed to bring up issues of concern. At a recent public County Council meeting, one resident expressed concern that 3 new coffee shops from a popular coffee shop chain were planning to open in the county, and the resident believed that this would create an increase in property crimes in the county. (Property crimes include burglary, larceny-theft, motor vehicle theft, and arson -- from *http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/property-crime accessed on December 5, 2012*.)
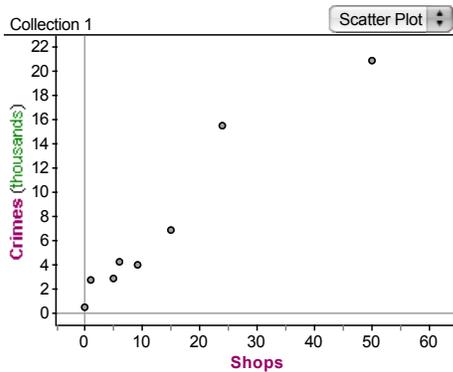
To support this claim, the resident presented the following data:

County	Shops	Crimes
A	9	4000
B	1	2700
C	0	500

D	6	4200
E	15	6800
F	50	20800
G	5	2800
H	24	15400

In order to have a better visual dipiction of the data, here is a scatterplot:
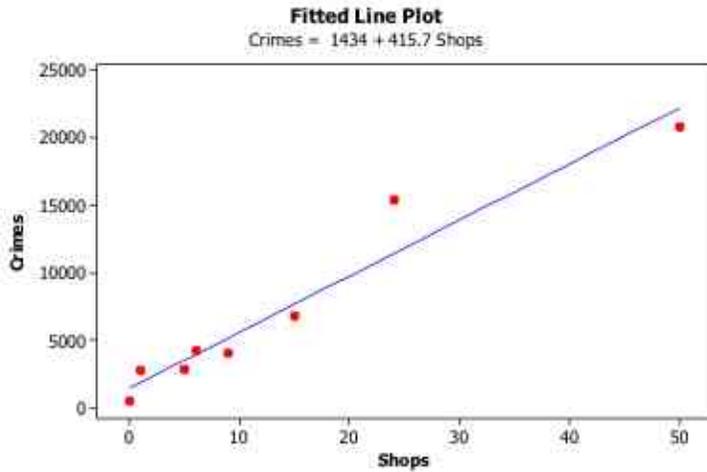

1. a) While referring to the scatterplot, discuss why there is scatter in the plot.
   b) Describe trends in the plot such as clustering, a positive or negative relationship, or a linear relationship that you can visually observe. Identify any unusual points.

All the counties except for two are essentially clustered together. They have a small number of coffee shops and a small number of crimes compared to the two other counties. There appears to be a positive association between the number of coffee shops and the number of crimes. This means that as the shops increase, we see the crimes increase. There also appears to be a linear relationship between the two variables. Even when considering the county that has a much higher number of shops and a much higher number of crimes, the point appears to be "on target" with the linear relationship determined by those counties that are closer or clustered together.

Grading Category	Solutions, Explanations, and Sample Answers
Essentially Correct (E)	An essentially correct answer will mention that the points cluster towards the low end, one county in particular has a much larger crime rate and larger number of coffee shops, positive association, statement about the meaning of a positive association, and a statement that the relationship appears to be linear.
Partially Correct (P)	A partially correct answer would address 3 to 4 of these points, but not all of them.
Incorrect (I)	An incorrect answer would fail to meet the criteria of E and P.

2. Using your pencil and a straightedge, draw a line on the plot that you believe best models the data. Write a) how you choose where to place the line and b) whether your reasoning could be applied to all possible scatterplots.

Fitted Line Plot
Crimes = 1434 + 415.7 Shops

Grading Category	Solutions, Explanations, and Sample Answers
Essentially Correct (E)	An essentially correct answer will have a line drawn with positive slope and near the given points. The description of how the line was placed must describe why it makes sense to place the line in that way. For example, someone might argue that they placed the line in such a way that it minimizes the error between what the line predicts and the actual data points.
Partially Correct (P)	A partially correct answer would place the line in such a way that it has positive slope but the student does not provide reasoning that could be applicable in all data situations. For example, someone who states that they placed the line in such a way that it goes through the most number of points would earn a P.
Incorrect (I)	An incorrect answer would fail to meet the criteria of E and P.

3. a) Interpret the slope of your line in the context of the problem.

   b) Describe how well the linear model fits the data.

Grading Category	Solutions, Explanations, and Sample Answers
Essentially Correct (E)	An essentially correct answer for (a) would estimate their slope and then interpret it in the context of the problem by stating that as the number of coffee shops increases by 1, then the number of crimes is expected to increase on average by Beta. An essentially correct answer for (B) would be: The line appears to fit the data quite well since the points are linearly aligned. There are no points that fall far away from the line.

Partially Correct (P)	A partially correct answer would answer either (a) or (b) correctly, but not both.
Incorrect (I)	An incorrect answer would fail to meet the criteria of E and P.

4. a) Use the line you drew to predict the number of crimes that would be expected given there were 10 coffee shops in a county. Explain your answer.

The line in the picture above has an equation of: Predicted Crimes=1434 + 415.7(Shops).

Therefore, if we have ten coffee shops in a county, we would expect there to be 5491 crimes.

b) Use the line you drew to predict the number of crimes that would be expected if there were 100 coffee shops in a county. How confident do you feel about the accuracy of your prediction? In other words, are there any issues with using your line to predict a crime level when the number of coffee shops is not within the range of coffee shops given in your data?

The line in the picture above has an equation of: Predicted Crimes=1434 + 415.7(Shops).

Therefore, if we have 100 coffee shops in a county, we would expect there to be 455,810 crimes. There are issues with using our equation to extrapolate values outside of our range of current values we fit our model too. For example, suppose I added the following two data points outside of our current range:

County Shops Crimes
| I | 51 | 10000 |
| J | 65 | 15000 |

This would drastically change our line and our predicted value would no longer make sense.

Grading Category	Solutions, Explanations, and Sample Answers
Essentially Correct (E)	An essentially correct answer would provide an accurate estimate of the number of crimes given the 10 and the 100 coffee shops by using their line of best fit. This could either be done by eye-balling it or actually finding an equation of the line either through eye-ball estimation or technology and finding the exact value. *Note: technology is not required to obtain an E.* Then, to earn an E, someone must recognize that if other values were given outside of the range of values given, this could drastically change the line and thus change the prediction. Another way to state this is that 100 coffee shops is well beyond the range of data and we don't know if the trend seen in the current data set would hold true for values outside of the current domain, like 100. Thus extrapolation in this setting is problematic.
Partially Correct (P)	A partially correct answer will get either (a) or(b)

	correct but not both.
Incorrect (I)	An incorrect answer would fail to meet the criteria of E and P.