

Unit C: Usage of Graphics in Agricultural Economics

Lesson 3: Understanding the Relationship of Data, Graphics, and Statistics

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Formulate logical and accurate conclusions from data illustrated in graphics.
2. Utilize statistics to make conclusions from data.

Recommended Teaching Time: 1 hour

Recommended Resources: The following resources may be useful in teaching this lesson:

<http://www.statcan.ca/english/edu/power/toc/contents.htm>
<http://www.utas.edu.au/sciencelinks/exdesign/AI4A.HTM>
http://mathforum.org/library/drmath/sets/select/dm_mean_median.html
http://www.wtamu.edu/academic/anns/mps/math/mathlab/beg_algebra/beg_alg_tut_9_bar.htm
<http://members.tripod.com/~RichardBowles/maths/correlation/corr.htm>

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Students' "Graphics and Statistics" Know Books
Copies of WS 3-1
Copies of WS 3-2
Copies of LS 3-1
Data from a local farmer or agribusiness man for LS 1-1

Terms:

Correlation	Plateau
Erratic	Positive Correlation
Gradual	Outlier
Interpretation	Range
Mean	Rapid
Median	Steady
Mode	Steep
Negative Correlation	Strong Correlation
Peak	Valley
	Weak Correlation

Interest Approach: Draw a line graph on the writing surface. A graphic using variables that are relevant to students would be best. Ideas include the average scores on the most recent 5 assignments or the highest score from each of the 5 most recent assignments. Ask students to describe the line. Ask students what they can conclude or learn from this data. Help students realize that data and graphics exist to prove facts and make conclusions.

Summary of Content and Teaching Strategies

To assist students in understanding Objectives 1, 2, and 3, use the PowerPoint Presentation. Students should continue to write information in the Graphics and Statistics Know Book. Guide students in writing down this information with each lesson objective listed at the top of the page and content information written below.

Objective 1: Formulate logical and accurate conclusions from data illustrated in graphics.

Anticipated Problem: How are conclusions made from data illustrated in graphics?

PowerPoint Slide #3

- I. Logical conclusions can be made using data collected by an individual or provided by an organization. These conclusions can be used to assist business owners in making decisions by tracking past profits, forecasting future prices, and utilizing other information related to the business.

PowerPoint Slide #4

- A. For most individuals, conclusions are most easily made with data that is illustrated in graphics. Data in written text or tables can be transferred into graphics or studied by the reader to make accurate conclusions.
- B. To make conclusions, data and graphics are interpreted. Correlations may be found to assist in making conclusions. **Interpretation** of data and graphics is completed by identifying trends and patterns. A **correlation** describes the relationship between two variables.

PowerPoint Slide #5

1. Line graphs easily show increasing or decreasing trends. These trends are seen by the change in the line or lines.
 - a. An increase occurs when the increase of one variable causes the increase of the other variable
 - b. A decrease occurs when the increase of one variable causes the decrease of the other variable.

PowerPoint Slide #6

2. These trends, or changes, may occur **gradually** or **rapidly**. The way these trends change may also occur **steadily** or **erratically**.
 - a. A gradual change is one that occurs slowly.
 - b. A rapid change is one that occurs very quickly.

PowerPoint Slide #7

- c. A steady change is one that occurs at the same rate constantly.
- d. An erratic change is one that occurs at no regular rate.

PowerPoint Slide #8

- e. Trends can also be found on line graphs to show other characteristics.
 - i. A **plateau** occurs when one variable begins to effect a change in another variable, but later has no effect. This will be seen as a line that has made a constant change, but then levels off.

PowerPoint Slide #9

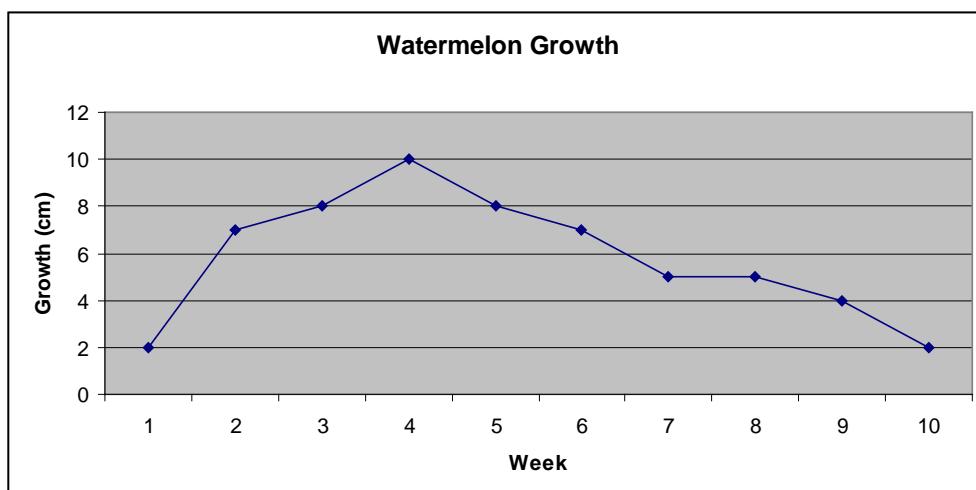
- ii. A **peak** occurs when the increase in one variable causes an increase, then a decline in the other variable.
- iii. A **valley** occurs when the increase in one variable causes a decrease, then an increase in the other variable.

PowerPoint Slide #10

- iv. A trend may also change constantly but then become **steep**. When this happens, the line is changing gradually, but suddenly becomes perpendicular or nearly perpendicular. This change occurs because the change in one variable suddenly affected the other variable differently. The trend becomes steep because a slight change in one variable greatly affects the other variable.
- f. Some bar graphs also show these types of trends.

PowerPoint Slides #11 and 12

- g. Example Problem: The length of a watermelon vine was recorded for 10 weeks after the seed had germinated.
Describe the data illustrated in graphics. *The length of the watermelon vine increased rapidly and peaked at 10 cm of growth during week 4. The growth then gradually slowed to only 2 cm in week 10.*
What conclusions can be made from this data? *This watermelon vine grew rapidly in the first 4 weeks, then growth steadily slowed down during weeks 5-10.*

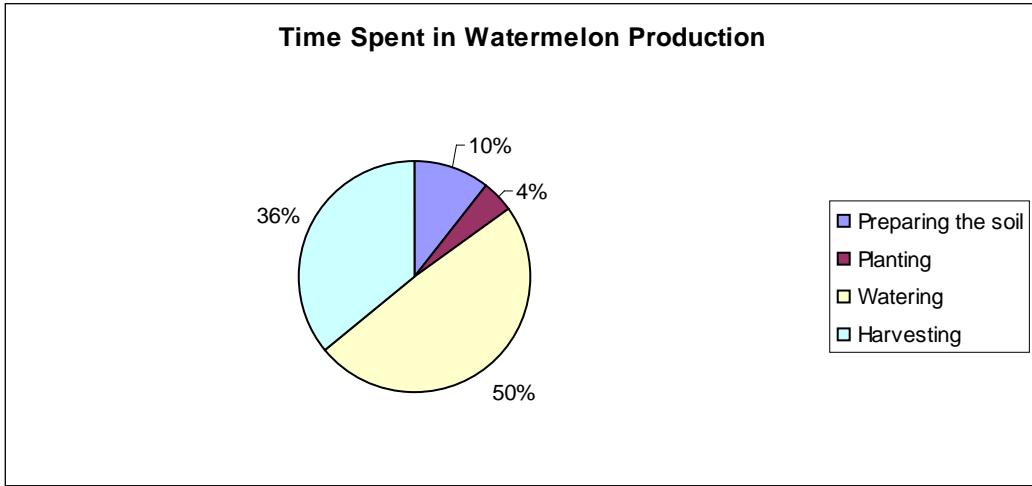


PowerPoint Slide #13

- 2. Pie charts and cosmographs easily compare the parts that make up the total subject.
 - a. These graphics show which parts make up the smallest and largest portions of the total.

PowerPoint Slides #14 and 15

- b. Example Problem: Records were kept for the hours of labor that were spent on a watermelon enterprise.
Describe the data illustrated in the graphic. *The most time was spent watering while the least time was spent planting on the watermelon enterprise.*
What conclusions can be made from this data? *Half (50%) of the labor in the watermelon operation is used for watering the plants. Harvesting the watermelons also requires a significant amount of labor (36%). Some time must be spent preparing the soil (10%). The least amount of labor is used to plant the seeds(4%).*



PowerPoint Slide #16

3. Scatter plots easily show the relationship between two variables.
 - a. Correlations are easily viewed on scatter plots.

PowerPoint Slide #17

- i. A **positive correlation** exists between two variables when the increase in one variable causes an increase in the other variable.
- ii. A **negative correlation** exists between two variables when the increase in one variable causes a decrease in the other variable.

PowerPoint Slide #18

- iii. Occasionally, two variables will have no correlation when the change in one variable does not cause a specific change in the other variable.

PowerPoint Slide #19

- b. One basic way to determine the correlation, is to draw a circle or oval around the majority of the points.
 - i. **Outliers** are data that are obviously different in value than other data and should not be included within the circle. Outliers are sometimes caused by an error when recording the data or are an uncommon occurrence.
 - ii. If outliers are included, the correlation or statistics can often be misleading.

PowerPoint Slide #20

- c. When the shape has been drawn around the points, it should be examined to determine if a positive, negative, or no correlation exists.
- d. If a positive or negative correlation exists, it may be a strong or weak correlation.

PowerPoint Slide #21

- i. A **strong correlation** is one that shows a close relationship between two variables. This type of correlation will appear as a very narrow oval. Another way to identify a strong correlation is by drawing a straight best fit line through the points, all points will lie closely to that line.

PowerPoint Slide #22

- ii. A **weak correlation** is one that shows a some relationship between two variables, but the relationship is not as strong. This correlation will appear as a wide oval, almost circular in shape. If a best fit line is drawn through the points, some points will lie close to the line, but others will not.

PowerPoint Slide #23

- e. When best fit lines are drawn on scatter plots, conclusions can be made similar to those made on line graphs
- f. Some double bar graphs also show the relationship between two variables.

PowerPoint Slides #24 and 25

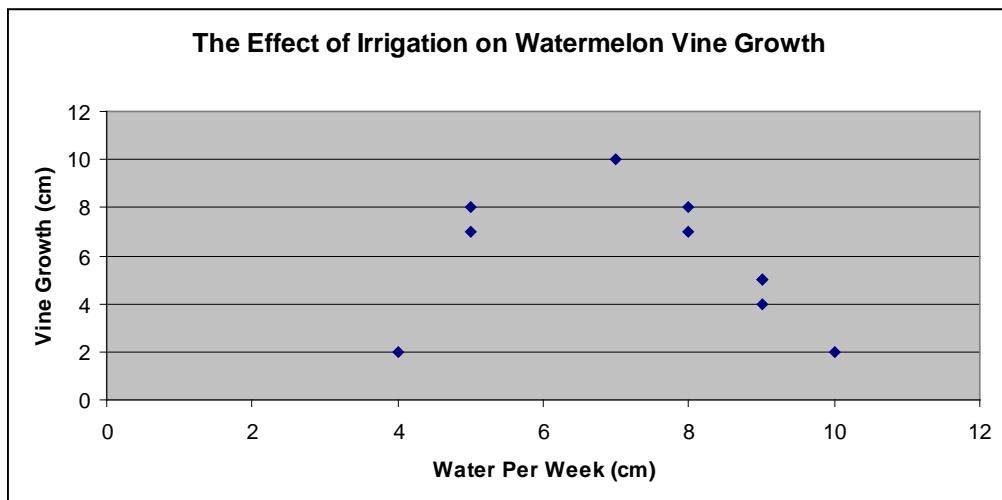
- g. Example Problem: The length of a watermelon vine and the amount of water used to irrigate the plant was recorded.

Describe the data illustrated on the graphic.

No correlation exists for this data.

What conclusions can be made from this data?

The amount of water irrigated onto watermelons does not effect the growth of watermelon vines.



Objective 2: Utilize statistics to make conclusions from data.

Anticipated Problem: How are statistics utilized to make conclusions from data?

PowerPoint Slide #26

- II. Simple statistics can be used to make basic conclusions about a data set.

A. The **range** defines how spread out the data are.

PowerPoint Slide #27

1. To find the range, subtract the smallest data value from the greatest data value
2. Data with large ranges are more spread out.
3. Example Problem: The temperature was recorded for 10 days.

Day	High Temperature in Degrees Celsius
1	24
2	27
3	26
4	24
5	30
6	29
7	28
8	31
9	35
10	33

PowerPoint Slide #28

What is the range? $35 - 24 = 11$

What conclusion can be made from this statistic? *Within the 10 days that data was recorded, the temperature differed 11 degrees Celsius.*

PowerPoint Slide #29

- B. The **mean** is the average of all the data.

1. To find the mean, sum the values of all data. Then divide the total by the number of data.
2. Example Problem: The temperature was recorded for 10 days.

<u>Day</u>	<u>High Temperature in Degrees Celsius</u>
1	24
2	27
3	26
4	24
5	30
6	29
7	28
8	31
9	33
10	35

PowerPoint Slide #30

What is the mean? $24+27+26+24+30+29+28+31+33+35=287$
 $287 / 10 = 28.7$

What conclusion can be made from this statistic? *The average temperature in these 10 days was 28.7 degrees Celsius.*

PowerPoint Slide #31

- C. The **mode** is the data value that occurs most often within the data set.
1. To find the mode, look at the data. Count the number of times each value occurs. The value that occurs the most number of times is the mode.
 2. Example Problem: The temperature was recorded for 10 days.

<u>Day</u>	<u>High Temperature in Degrees Celsius</u>
1	24
2	27
3	26
4	24
5	30
6	29
7	28
8	31
9	33
10	35

PowerPoint Slide #32

What is the mode? 24 (it occurs twice)

What conclusion can be made from this statistic? *The temperature that occurred most often was 24 degrees Celsius.*

PowerPoint Slide #33

- D. The **median** is the middle data value.
1. To find the median, place the values in order from least to greatest. The median value is the value that has an equal number of values above and below it. If no one value is exactly in the middle, find the mean of the two middle values to be the median number.

2. Example Problem: The temperature was recorded for 10 days.

Day	High Temperature in Degrees Celsius
1	24
2	27
3	26
4	24
5	30
6	29
7	28
8	31
9	33
10	35

PowerPoint Slide #34

What is the median? 24, 24, 26, 27, 28, 29, 30, 31, 33, 35

(28 and 29 are the middle values) $28 + 29 = 57$

$$57 / 2 = 28.5$$

What conclusion can be made from this statistic? *The middle temperature was 28.5 degrees Celsius.*

*****Additional examples or problems may need to be developed for students to practice the interpretation skills for mastering Objectives 1 and 2. Develop problems and worksheets as needed to ensure that students fully comprehend and master these skills.**

Review/Summary: Complete WS 3-1 and WS 3-2. Guide students as they complete each worksheet. Check and discuss the answers to with students. Realize that student answers may differ slightly from those listed on WS 3-1 KEY and WS 3-2 KEY. Accept all correct answers. Be sure to discuss all of these answers with students.

Application: Collect sample data from a local farmer or agribusinessman. If possible, ask the individual to come in and speak to students about how he uses data, graphics, and statistics within his farm or agribusiness. Write sample data on the writing surface or dictate the data so that students may use it to complete LS 1-1.

Evaluation: A sample written test is attached.

Answers to Test:

Part One: Matching

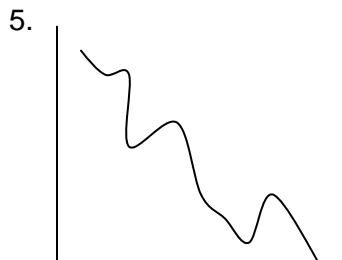
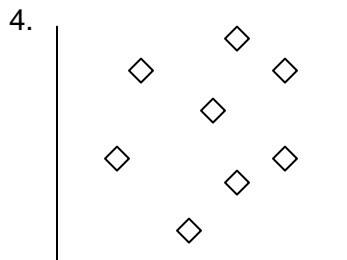
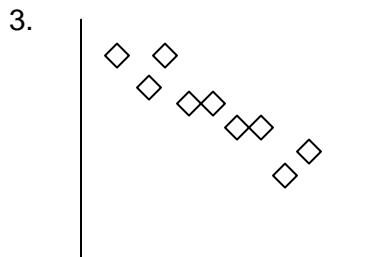
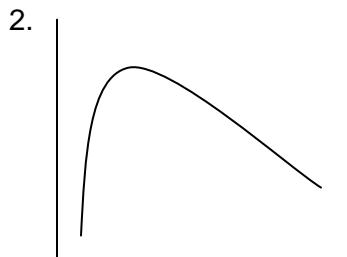
1 = f, 2 = d, 3 = a, 4 = g, 5 = j, 6 = c, 7 = d, 8 = b, 9 = i, 10 = h

Part Two: Completion

- 1 = positive correlation
- 2 = smallest, greatest
- 3 = correlation
- 4 = line graphs
- 5 = interpretation

Part Three: Short Answer

1. When data is interpreted, a conclusion can be made. These conclusions can be used for making wise business decisions.



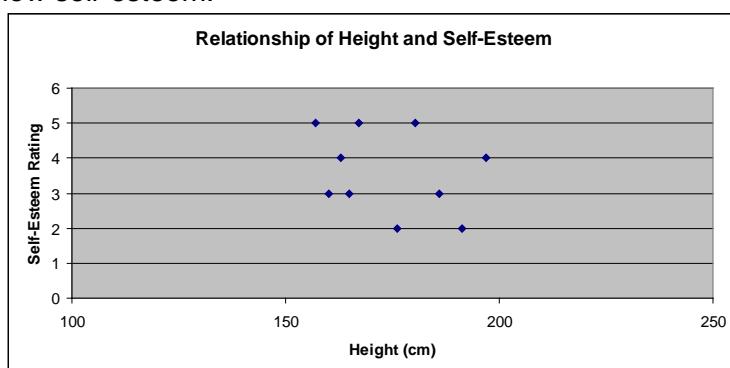
***Student answers for numbers 2-5 may look different than those shown above. Use Objectives 1 and 2 to check the accuracy of student answers.

Understanding the Relationship of Data, Graphics, and Statistics

Instructions. Use the information in your Graphics and Statistics Know Book to complete the following problems.

1. Describe each graphic below, then give an interpretation of the data.

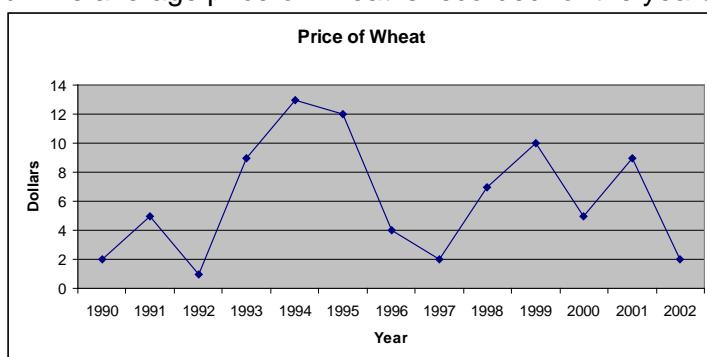
- a. A survey of 10 males asked for their height and a rating of their self-esteem. For self-esteem a scale from 1 to 5 was used with 5 being high self-esteem and 1 being low self-esteem.



Description:

Interpretation:

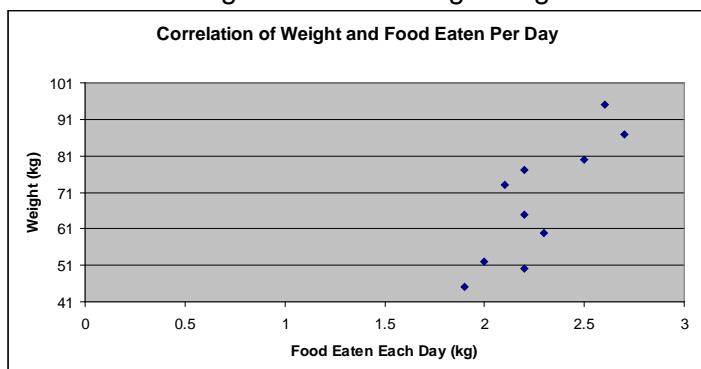
- b. The average price of wheat is recorded for the years 1990 to 2002.



Description:

Interpretation:

- c. Ten individuals weighed and recorded the amount of food they ate for one week. Their current weight and the average weight of food eaten per day are recorded.



Description:

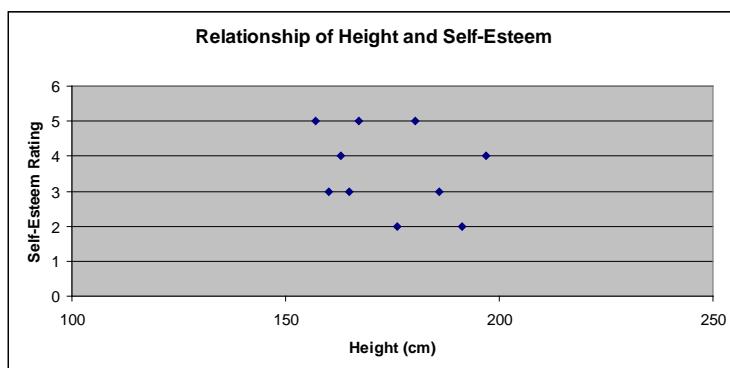
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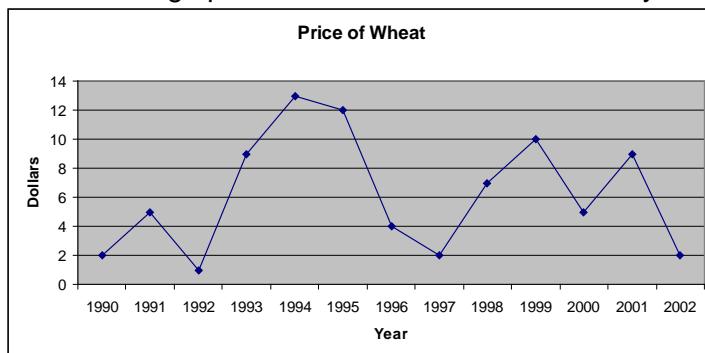
- a. A survey of 10 males asked for their height and a rating of their self-esteem. For self-esteem a scale from 1 to 5 was used with 5 being high self-esteem and 1 being low self-esteem.



Description: There is no correlation between height and self-esteem.

Interpretation: A person's height has no effect on their self-esteem.

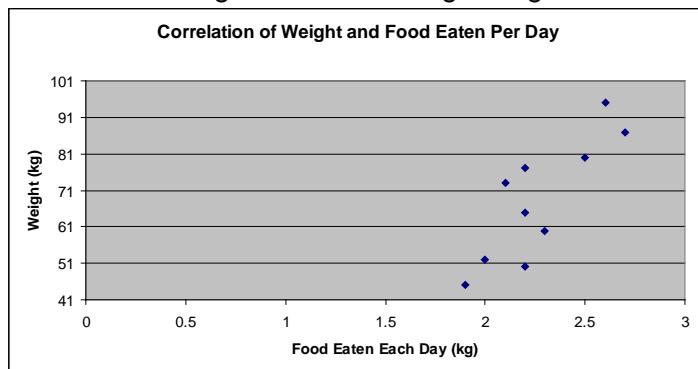
- b. The average price of wheat is recorded for the years 1990 to 2002.



Description: From 1990-2002, the price of wheat has changed erratically, peaking at \$13 in 1994. A valley was also seen in 1997 at \$2. The price range during this time is \$12.

Interpretation: The price of wheat from 1990-2002 changed drastically from year to year. The price has seen a difference of \$12 during this time.

- c. Ten individuals weighed and recorded the amount of food they ate for one week. Their current weight and the average weight of food eaten per day are recorded.



Description: A strong, positive correlation exists between the weight of a person and the amount of food they eat each day.

Interpretation: In general, the more food a person eats, the more they weigh.

Understanding the Relationship of Data, Graphics, and Statistics

Instructions. Use the information in your Graphics and Statistics Know Book to complete the following problems.

Robert has collected data from his goat enterprise. He is trying to improve his management of the goats. Create graphics to help him make conclusions about what he might do to improve.

Birth Date	Goat ID	Weight Gain				
		1 June 2008	8 June 2008	15 June 2008	22 June 2008	29 June 2008
1 March 08	1	.5 kg	.5 kg	.9 kg	.4 kg	.9 kg
8 March 08	2	.3 kg	.4 kg	.9 kg	.6 kg	.8 kg
30 April 08	3	.4 kg	.5 kg	.8 kg	.6 kg	.8 kg

Mineral Supplement was given on: 8 June 2008 and 22 June 2008

1. Create a line graph to show how the goats gained weight.

2. Create a scatter plot to show the relationship between birth date and weight gain.

3. What conclusions can be made? What recommendations would you give to for the improvement of the goat enterprise?

Understanding the Relationship of Data, Graphics, and Statistics

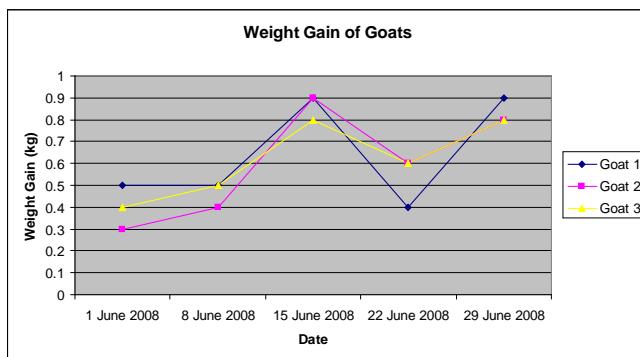
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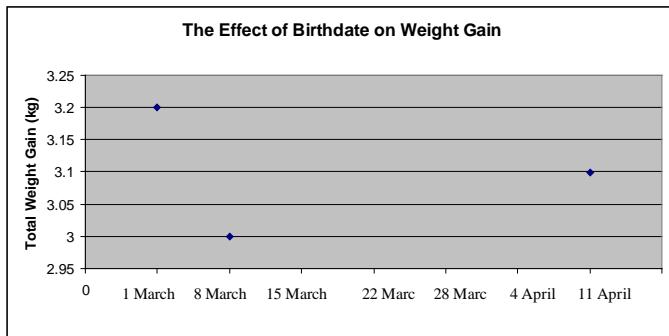
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Mineral Supplement was given on: 8 June 2008 and 22 June 2008

1. Create a line graph to show how the goats gained weight.



2. Create a scatter plot to show the relationship between birth date and weight gain.



3. What conclusions can be made? What recommendations would you give to for the improvement of the goat enterprise?

As the goats get older, they gain weight. Rapid weight increases occur during the week that they are fed the mineral supplement. There is no correlation between birth date and the total. To increase the weight of his goats quicker, he should feed mineral supplement more often.

Test

Understanding the Relationship of Data, Graphics, and Statistics

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- a. peak
- b. gradual
- c. valley
- d. strong correlation
- e. negative correlation

- f. median
- g. mean
- h. mode
- i. erratic
- j. outlier

- _____ 1. The middle data value.
- _____ 2. A close relationship between two variables.
- _____ 3. Occurs when the increase in one variable causes an increase, then a decline in the other variable.
- _____ 4. The average of all the data.
- _____ 5. Data that are obviously different in value than other data.
- _____ 6. Occurs when the increase in one variable causes a decrease, then an increase in the other variable.
- _____ 7. This exists between two variables when the increase in one variable causes a decrease in the other variable.
- _____ 8. A slow, steady change.
- _____ 9. A change that occurs at no regular rate.
- _____ 10. The data value that occurs most often within the data set.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

- 1. When the increase in one variable causes an increase in the other variable, a _____ exists.
- 2. To find the range of a data set, subtract the _____ value from the _____ value.
- 3. A _____ describes the relationship between two variables.
- 4. _____ easily show increasing or decreasing trends.
- 5. _____ of data and graphics is completed by identifying trends and patterns.

Test

Name _____

Test

Understanding the Relationship of Data, Graphics, and Statistics

Part Three: Short Answer

Instructions. Use complete sentences and correct spelling to provide the information below.

1. What is the purpose of interpreting data?
 2. Draw a line graph that shows a rapid increase that peaks and gradually decreases.
 3. Draw a scatter plot that shows a strong, negative correlation with at least 8 points.
 4. Draw a scatter plot that shows no correlation with at least 8 points.
 5. Draw a line graph that shows an erratic, decreasing trend.

Lab Sheet

Part One

Instructions. Utilize the data provided by the instructor to complete the following items.

1. *Draw a graphic to represent the data.*

2. *Describe the data as it is illustrated on the graphic.*

3. *What is the range? _____*

4. *What is the mean? _____*

5. *What is the median? _____*

6. *What is the mode? _____*

7. *What conclusions can be made from the graphic and statistics?*

8. *Can improvements be made to the enterprise based upon this data? What improvements do you recommend?*