

Television and Test Grades

A-E Strand(s): Probability/Statistics and Number

Topic/Expectation

PS.A.4 Linear trends

- a. Determine whether a scatter plot suggests a linear trend.

PS.C.2 Correlation and regression

- a. Determine a line of good fit for a scatter plot.

Other Topic/Expectation(s)

PS.B.2 Analyze and interpret categorical and quantitative data

- d. Read, interpret, interpolate and judiciously extrapolate from graphs and tables.

Rationale

This task allows students to analyze data sets that they might typically collect to set up scatter plots. Students then determine linear trends and lines of good fit when they exist.

Instructional Task

1. Students in Ms. Garth's Algebra II class wanted to see if there are correlations between test scores and height and between test scores and time spent watching television. Before the students began collecting data, Ms. Garth asked them to predict what the data would reveal. Answer the following questions that Ms. Garth asked her class.
 - a. Do you think students' heights will be correlated to their test grades? If you think a correlation will be found, will it be a positive or negative correlation? Will it be a strong or weak correlation?
 - b. Do you think the average number of hours students watch television per week will be correlated to their test grades? If you think a correlation will be found, will it be a positive or negative correlation? Will it be a strong or weak correlation?
2. The students then created a table in which they recorded each student's height, average number of hours per week spent watching television (measured over a four-week period), and scores on two tests. Use the actual data collected by the students in Ms. Garth's class, as shown in the table below, to answer the following questions.

Student	1	2	3	4	5	6	7	8	9	10	11	12	13
Height (in inches)	60	65	51	76	66	72	59	58	70	67	65	71	58
TV hrs/week (average)	30	12	30	20	10	20	15	12	15	11	16	20	19
Test 1	60	80	65	85	100	78	75	95	75	90	90	80	75
Test 2	70	85	75	85	100	88	85	90	90	90	95	85	85

- Which pairs of variables seem to have a positive correlation? Explain.
 - Which pairs of variables seem to have a negative correlation? Explain.
 - Which pairs of variables seem to have no correlation? Explain.
- For each pair of variables listed below, create a scatter plot with the first variable shown on the y -axis and the second variable on the x -axis. Are the two variables correlated positively, correlated negatively, or not correlated? Determine whether each scatter plot suggests a linear trend.
 - Score on test 1 versus hours watching television
 - Height versus hours watching television
 - Score on test 1 versus score on test 2
 - Hours watching television versus score on test 2
 - Using the statistical functions of your graphing calculator, determine a line of good fit for each scatter plot that suggests a linear trend.

Discussion/Extension/Notes

Before beginning the task, ask the class what they know about correlation. Remind them that the correlation coefficient, a measure of how closely two variables are related, is a number between -1 and 1 . If the values of both variables tend to increase (or if the values of both decrease), the two variables are positively correlated. If one variable tends to decrease as the other increases (or vice versa), the two variables are negatively correlated. If the values of the variables in both sets do not demonstrate a relationship, the variables are not correlated. Determining a relationship between two sets of data, especially from a scatter plot, may be subject to interpretation. The teacher will likely want to have students use a graphing calculator with statistical capabilities to do this task, determining ahead of time which features on the calculator are appropriate.

Lines of good fit may be found using paper-and-pencil techniques (such as writing the equation based on two points) or using a graphing calculator (either generating possible lines to use for

guessing and checking or using the regression feature of the calculator to determine a particular function rule).

Sample Solutions

1. Students in Ms. Garth's Algebra II class wanted to see if there are correlations between test scores and height and between test scores and time spent watching television. Before the students began collecting data, Ms. Garth asked them to predict what the data would reveal. Answer the following questions that Ms. Garth asked her class.

- a. Do you think students' heights will be correlated to their test grades? If you think a correlation will be found, will it be a positive or negative correlation? Will it be a strong or weak correlation?

Answers may vary, but a possible answer could be: "I do not think there will be correlation between height and test grades, since it is not reasonable to think a person's height affects their intelligence or effort level."

- b. Do you think the average number of hours students watch television per week will be correlated to their test grades? If you think a correlation will be found, will it be a positive or negative correlation? Will it be a strong or weak correlation?

Answers may vary, but a possible answer could be: "I think the average number of hours a student watches television will be negatively correlated with the student's test grades. It is reasonable to think that the more TV you watch, the less time you spend studying, resulting in low test grades. However, it does not seem like these variables will be strongly correlated, since some people do not watch TV but do not spend time studying either. On the other hand, some students may watch a lot of TV and still study a lot."

2. The students then created a table in which they recorded each student's height, average number of hours per week spent watching television (measured over a four-week period), and scores on two tests. Use the actual data collected by the students in Ms. Garth's class, as shown in the table below, to answer the following questions.

Student	1	2	3	4	5	6	7	8	9	10	11	12	13
Height (in inches)	60	65	51	76	66	72	59	58	70	67	65	71	58
TV hrs/week (average)	30	12	30	20	10	20	15	12	15	11	16	20	19
Test 1	60	80	65	85	100	78	75	95	75	90	90	80	75
Test 2	70	85	75	85	100	88	85	90	90	90	95	85	85

- a. Which pairs of variables seem to have a positive correlation? Explain.

Test 1 scores and test 2 scores appear to be positively correlated. For the most part, student performance on both tests was fairly consistent, so students who did well on test 1 also did well on test 2, while those who did not do well on test 1 didn't do very well on test 2 either.

- b. Which pairs of variables seem to have a negative correlation? Explain.

Test 1 scores and hours per week watching television, and test 2 scores and hours per week watching television appear to be negatively correlated. In general, students who spent more time watching television had lower test scores than those who spent less time watching television.

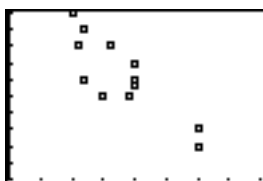
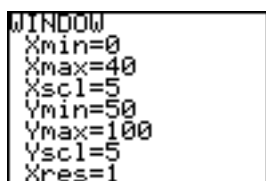
- c. Which pairs of variables seem to have no correlation? Explain.

Height and hours per week watching television, test 1 scores and height, and test 2 scores and height seem to have no correlation. Height does not seem to be correlated with any of the other variables. That is, taller students do not seem to watch any more or less television or perform any better or worse on tests than shorter students.

3. For each pair of variables listed below, create a scatter plot with the first variable shown on the y-axis and the second variable on the x-axis. Are the two variables correlated positively, correlated negatively, or not correlated? Determine whether each scatter plot suggests a linear trend.

- a. Score on test 1 versus hours watching television

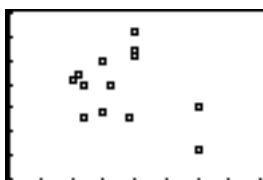
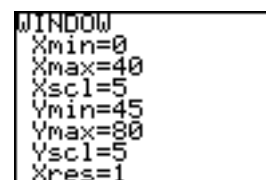
Scatter Plot:



Correlation? *Negative*. Linear Trend? *Yes*.

- b. Height versus hours watching television

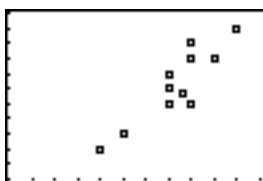
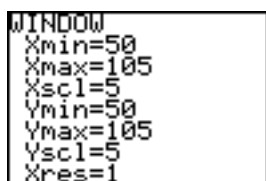
Scatter Plot:



Correlation? *No correlation*. Linear Trend? *No*.

- c. Score on test 1 vs. score on test 2

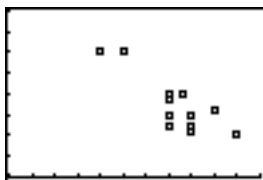
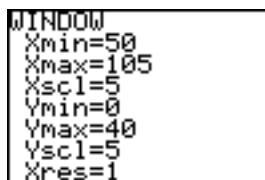
Scatter Plot:



Correlation? *Positive*. Linear Trend? *Yes*.

- d. Hours watching television versus score on test 2

Scatter Plot:



Correlation? *Negative*. Linear Trend? *Yes*.

4. Using the statistical functions of your graphing calculator, determine a line of good fit for each scatter plot that suggests a linear trend.

Answers may vary slightly from the ones shown here.

Using linear regression and rounding to the hundredths place:

a. Score on Test 1 versus hours watching television: $y = -1.43x + 105.98$

b. Height versus hours watching television: *no linear trend*

c. Score on test 1 versus score on test 2: $y = 1.32x - 33.04$

d. Hours watching television versus score on test 2: $y = -0.72x + 79.64$

Alternatively, using two points that appear to be close to a good representation of the trend in the data:

Data from score on test 1 versus hours spent watching television: (20, 78) and (11, 90)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{90 - 78}{11 - 20} = \frac{12}{-9} = \frac{-4}{3} \approx -1.33$$

$$y - y_1 = m(x - x_1)$$

$$y - 90 = \frac{-4}{3}(x - 11)$$

$$y - 90 = \frac{-4}{3}x + \frac{44}{3}$$

$$y = \frac{-4}{3}x + \frac{314}{3}$$

$$y = -1.33x + 104.67$$