Algebra I & Math I

Linear Regression

**Correlation**

The **correlation coefficient, r** measures the strength of a linear relationship.

The equation for calculating the correlation coefficient by hand is: $r=\frac{1}{n-1}\sum\_{}^{}\left(\frac{x\_{i}-\overbar{x}}{s\_{x}}\right)\left(\frac{y\_{i}-\overbar{y}}{s\_{y}}\right)$. This is a pretty complicated calculation to do by hand! We are going to let our calculator do all the hard work. Our role is to know what the correlation coefficient means and how to interpret in the context of a problem.

To calculate the correlation coefficient, you must first turn this feature on in your calculator. This only needs to be done one time, and will remain on until you either turn it off or take out the calculator’s batteries.

**To “Turn On” the Corrleation Coefficient**

1. Press Catalog.
2. Scroll down to DiagnosticOn
3. Press Enter twice.

***Now enter the data and calculate the equation of the line of best fit using the instructions below.***

**Enter Data**

1) Press STAT, select 1: Edit

2) Enter data into L1, L2. Typically we place the values of x in L1 and the values of y in L2.

(If L1 or L2 already contain data, move the curse to the column heading and press Clear and then Enter.)

**To Calculate the LINE OF BEST FIT and the Correlation Coefficient, r**

 1) Press STAT, and use the cursor to select CALC at the top

2) Select 4: LinReg (ax + b).

3) Press ENTER again once “LinReg (ax + b)” appears on your main screen.

4) “a” on the calculator is your slope (m)

“b” on the calculator is your y-intercept (b)

5) Record your regression equation using the “a” and “b”

6) Record your correlation coefficient, r

You will also see r2 which is called the coefficient of determination. If you take the square root of r2, you get r, the correlation coefficient. In Statistics, we sometimes work with r2, but in this class we will focus on using r.

**Activity**

1. On the next two pages are cards which each contain a different data set. Cut out the cards and give two cards to each member of your group.
2. Group members should create a scatterplot and then calculate the equation for the line of best fit and the correlation coefficient for each of their cards.
3. Once all cards are completed, lay the cards out in order from largest correlation coefficient to smallest correlation coefficient.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Set A

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 1 | 1.5 | 2.5 | 1.9 | 2.8 | 3.2 | 4.5 | 3.7 | 1.7 | 4.8 | 2.7 | 2.3 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ | Set B

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 1 | 1.5 | 2.5 | 1.9 | 2.8 | 3.2 | 4.5 | 3.7 | 4 | 4.8 | 5 | 4.6 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ |
| Set C

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 4.9 | 4.2 | 3.9 | 3.5 | 3.2 | 3.1 | 2.6 | 3.2 | 2.1 | 1.3 | 0.8 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ | Set D

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 3.1 | 4.2 | 2.5 | 2.8 | 3.2 | 1.9 | 3 | 3.2 | 1.8 | 1.1 | 2.9 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ |
| Set E

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 4 | 4.2 | 3.9 | 2.8 | 3.2 | 4.5 | 3.7 | 3.2 | 4.8 | 5 | 4.4 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ | Set F

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| --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 |
| 1.8 | 2.22 | 3.62 | 4.18 | 4.88 | 5.44 | 5.3 | 6 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ |
| Set G

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 |
| 4.4 | 4.01 | 2.71 | 2.19 | 1.54 | 1.02 | 1.15 | 0.5 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ | Set H

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 0 | 0 | 6 | 0 | 10 | 2 | 10 | 10 | 0 | 6 | 0 | 10 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_\_\_\_\_\_\_\_\_ |

**Record Your Observations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Data Set****Order from largest r value to smallest** | **Value of Correlation Coefficient, r** | **Value of the Slope of the Best Fit Line** | **Describe the Shape of the Graph****(Scattered, linear, curved, clusters on specific intervals)** |
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**Teacher Notes** Common Core Standards addressed by this activity:

Content Standards

|  |  |  |  |
| --- | --- | --- | --- |
| Supporting | S | ID.6 | **S-ID.6** Summarize, represent, and interpret data on two categorical and quantitative variables. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.\****S-ID.6a*** Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.\****S-ID.6b*** Informally assess the fit of a function by plotting and analyzing residuals.\* ***S-ID.6c*** Fit a linear function for a scatter plot that suggests a linear association.\* |
| Major | S | ID.8 | ***S-ID.8*** Interpret linear models. Compute (using technology) and interpret the correlation coefficient of a linear fit.\* |

Primary Math Practices

MP 2 Reason abstractly and quantitatively.

MP 3 Construct viable arguments and critique the reasoning of others.

MP 6 Attend to precision.

**Answer Key**

|  |  |  |  |
| --- | --- | --- | --- |
| **Set****Order from largest r value to smallest** | **Value of Correlation Coefficient, r** | **Value of the Slope of the Best Fit Line** | **Describe the Shape of the Graph****(Scattered, linear, curved, clusters on specific intervals)** |
| F | 1.0 | 1.4 | Points all lie in a perfect line. The slope of the line is positive. |
| B | 0.94 | 0.90 | Points are somewhat scattered, but tightly clustered. The trend of the data is fairly linear with the slope of the line is positive |
| A | 0.5 | 0.41 | Points are more scattered, but appear to rise to the right in a somewhat linear pattern |
| H | 0.33 | 1.10 | While a best fit line with a positive slope could be fitted to this data, the data appears to have some other relationship going on with quite a few points at 0 and at 10. |
| E | 0.07 | 0.03 | The points are scattered. The line of best fit is almost horizontal. There may be a slight curve in the data. |
| D | - 0.65 | - 0.45 | The points appear linear, but scattered. The slope of the linear pattern is negative. |
| C | - 0.94 | - 0.84 | The points appear to be slightly scattered, but tightly clustered and form a linear pattern. The slope of the line of best fit is negative. |
| G | - 1.0 | -1.3 | The points lie in a perfect line. The slope of the line is negative. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Set A

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 1 | 1.5 | 2.5 | 1.9 | 2.8 | 3.2 | 4.5 | 3.7 | 1.7 | 4.8 | 2.7 | 2.3 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_y = 0.41x + 0.89\_\_\_\_\_\_\_\_\_\_\_\_ r = \_\_0.50\_\_\_\_ | Set B

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 1 | 1.5 | 2.5 | 1.9 | 2.8 | 3.2 | 4.5 | 3.7 | 4 | 4.8 | 5 | 4.6 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_y = 0.90x - 0.69\_\_\_\_\_\_\_\_\_\_\_ r = \_\_0.94\_\_\_\_\_ |
| Set C

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 4.9 | 4.2 | 3.9 | 3.5 | 3.2 | 3.1 | 2.6 | 3.2 | 2.1 | 1.3 | 0.8 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_y = - 0.84x + 6.87\_\_\_\_\_\_\_\_\_ r = \_\_- 0.94\_\_\_\_\_ | Set D

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 3.1 | 4.2 | 2.5 | 2.8 | 3.2 | 1.9 | 3 | 3.2 | 1.8 | 1.1 | 2.9 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_y = - 0.45x + 4.88\_\_\_\_\_\_\_\_\_\_\_\_ r = \_- 0.65\_\_\_ |
| Set E

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 4.7 | 4 | 4.2 | 3.9 | 2.8 | 3.2 | 4.5 | 3.7 | 3.2 | 4.8 | 5 | 4.4 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_y = 0.03x + 3.88\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_0.07\_\_\_\_ | Set F

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 |
| 1.8 | 2.22 | 3.62 | 4.18 | 4.88 | 5.44 | 5.3 | 6 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_y = 1.4x - 1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_1.0\_\_\_\_\_\_ |
| Set G

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 |
| 4.4 | 4.01 | 2.71 | 2.19 | 1.54 | 1.02 | 1.15 | 0.5 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_y = -1.3 x + 7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_- 1.0\_\_\_\_\_ | Set H

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2.3 | 3.3 | 3.7 | 4.2 | 4.6 | 4.5 | 5 | 5.5 | 5.7 | 6.1 | 6.4 |
| 0 | 0 | 6 | 0 | 10 | 2 | 10 | 10 | 0 | 6 | 0 | 10 |

https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcSJm9D9PFMGpgp7nlYnrGWtq0qNWwz8jSiyAY_YPeWwkgLdwfmOEquation: \_\_\_y = 1.10x - .40\_\_\_\_\_\_\_\_\_\_\_\_\_\_ r = \_0.33\_\_\_\_\_ |