Sample A

| **Criteria** | **Teachers' mark** |
|---|---|
| Personal Engagement | 1 |
| Exploration | 2 |
| Analysis | 2 |
| Evaluation | 0 |
| Communication | 4 |
| **Total** | 9 |

An analysis of the relationship between temperature and rainfall.

In my investigation, I took data from an outside source, manipulated it and analyzed it.

I wanted to investigate the relationship between temperature and rainfall. Since I did not collect the data myself, there are no manipulated or measured variables, but for the purpose of analysis, temperature will serve as the independent variable because natural temperature cannot be manipulated, and rainfall the dependent variable because it is likely that rainfall depends on natural temperature, which is what is to be tested in this investigation. The constant variable of the data is time since the data is consecutive monthly intervals within the same three years.

Seattle, Washington has quite a bit of rain so I decided to make that city my target area. I then searched "historical rainfall data" on a web browser and came across this website: http://www.wunderground.com/history/. After searching the city of Seattle on the website, I looked up the target months and years then recorded them in the first table below.

Average Temperature and Average Rainfall Data: Seattle, WA, 2010-2012

| Month | Average Temperature ± 1.0 °F | | | Averages | Average Rainfall ± 0.01 in | | | Averages |
|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | | 2010 | 2011 | 2012 | |
| January | 47 | 42 | 40 | 43 | 0.20 | 0.15 | 0.17 | 0.17 |
| February | 47 | 39 | 43 | 43 | 0.13 | 0.11 | 0.10 | 0.11 |
| March | 49 | 46 | 43 | 46 | 0.11 | 0.19 | 0.21 | 0.17 |
| April | 51 | 46 | 51 | 49 | 0.11 | 0.12 | 0.07 | 0.10 |
| May | 55 | 53 | 56 | 55 | 0.09 | 0.09 | 0.08 | 0.09 |
| June | 60 | 59 | 59 | 60 | 0.07 | 0.04 | 0.08 | 0.06 |
| July | 66 | 64 | 65 | 65 | 0.01 | 0.03 | 0.02 | 0.02 |
| August | 66 | 66 | 68 | 67 | 0.02 | 0.00 | 0.00 | 0.01 |
| September | 62 | 64 | 62 | 63 | 0.13 | 0.03 | 0.00 | 0.05 |
| October | 54 | 53 | 54 | 54 | 0.15 | 0.07 | 0.19 | 0.14 |
| November | 44 | 43 | 47 | 45 | 0.15 | 0.18 | 0.29 | 0.21 |
| December | 44 | 39 | 42 | 42 | 0.29 | 0.03 | 0.25 | 0.19 |

As the values are measured in degrees Fahrenheit and inches, I converted these units to the international system of units (SI units), degrees Celsius and centimeters with the formulas below.

Inches to Centimeters Conversion Formula: x in × 2.54cm = y cm

Degrees Fahrenheit to Celsius Conversion Equation: $T_{(°C)} = (T_{(°F)} - 32) \times \frac{5}{9}$

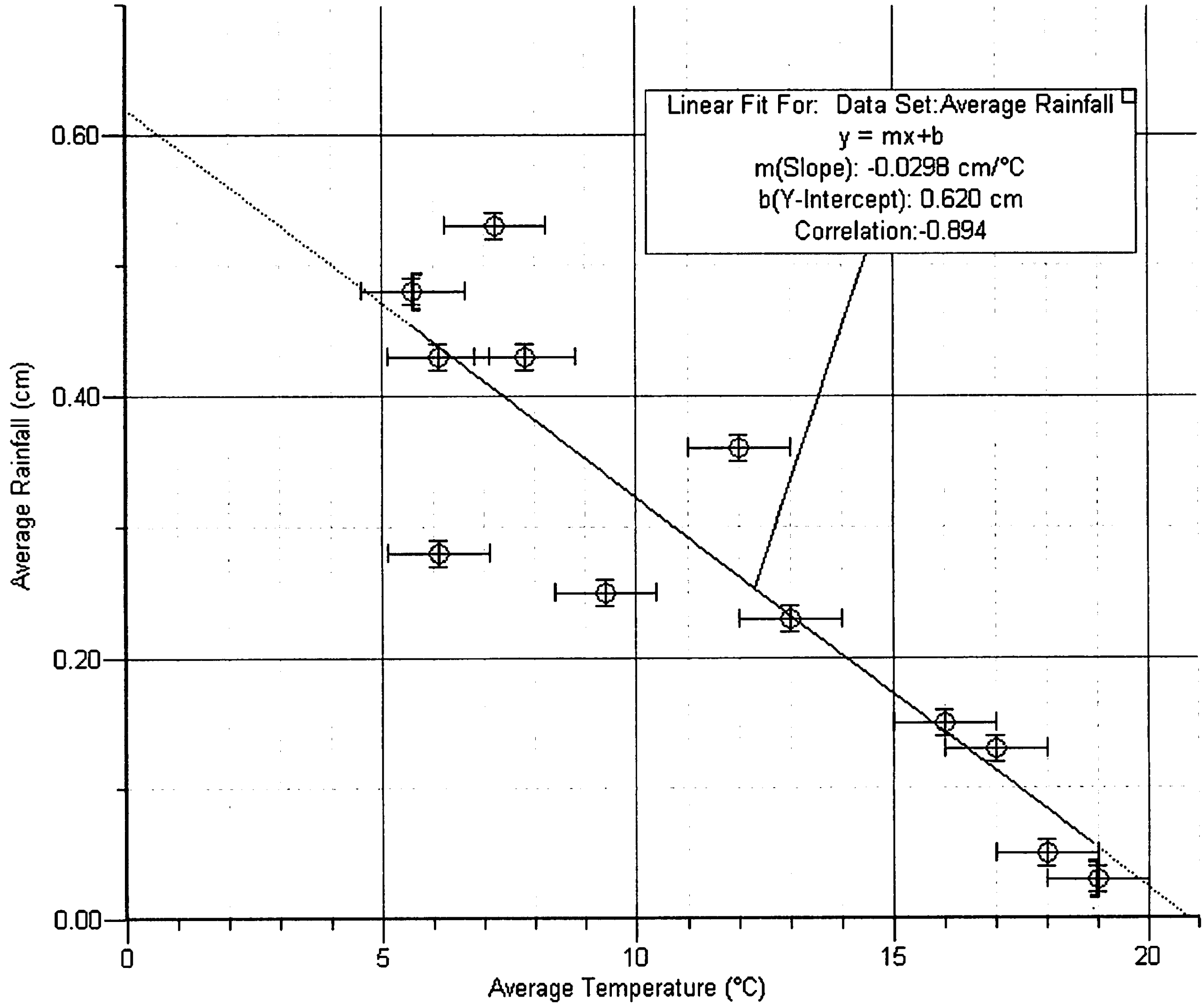
The results are shown in the table below.

| Month | Average Temperature (2010, 2011, 2012) ± 1.0 °F | Average Temperature (2010, 2011, 2012) ± 1.0 °F converted to ± 1.0 °C | Average Rainfall (2010, 2011, 2012) ± 0.01in | Average Rainfall (2010, 2011, 2012) ± 0.01 in inches converted to ± 0.01 centimeters |
|---|---|---|---|---|
| January | 43 | $(43 - 32) \times \frac{5}{9} = 6.1$ | 0.17 | 0.17 × 2.54 = 0.43 |
| February | 43 | $(43 - 32) \times \frac{5}{9} = 6.1$ | 0.11 | 0.11 × 2.54 = 0.28 |
| March | 46 | $(46 - 32) \times \frac{5}{9} = 7.8$ | 0.17 | 0.17 × 2.54 = 0.43 |
| April | 49 | $(49 - 32) \times \frac{5}{9} = 9.4$ | 0.10 | 0.10 × 2.54 = 0.25 |
| May | 55 | $(55 - 32) \times \frac{5}{9} = 13$ | 0.09 | 0.09 × 2.54 = 0.23 |
| June | 60 | $(60 - 32) \times \frac{5}{9} = 16$ | 0.06 | 0.06 × 2.54 = 0.15 |
| July | 65 | $(65 - 32) \times \frac{5}{9} = 18$ | 0.02 | 0.02 × 2.54 = 0.05 |
| August | 67 | $(67 - 32) \times \frac{5}{9} = 19$ | 0.01 | 0.01 × 2.54 = 0.03 |
| September | 63 | $(63 - 32) \times \frac{5}{9} = 17$ | 0.05 | 0.05 × 2.54 = 0.13 |
| October | 54 | $(54 - 32) \times \frac{5}{9} = 12$ | 0.14 | 0.14 × 2.54 = 0.36 |
| November | 45 | $(45 - 32) \times \frac{5}{9} = 7.2$ | 0.21 | 0.21 × 2.54 = 0.53 |
| December | 42 | $(42 - 32) \times \frac{5}{9} = 5.6$ | 0.19 | 0.19 × 2.54 = 0.48 |

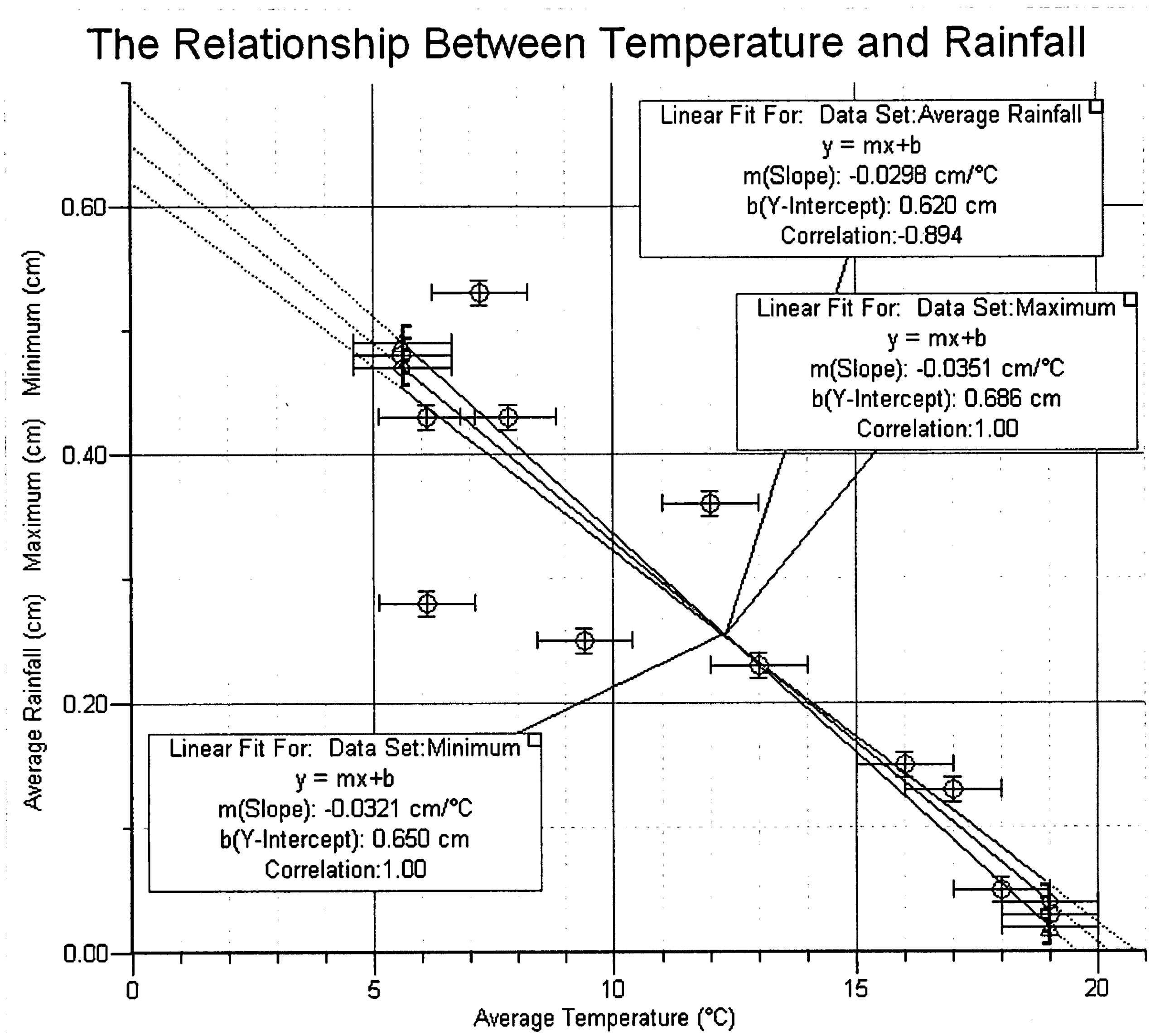
Final Average Temperature and Average Rainfall Values (to be graphed)

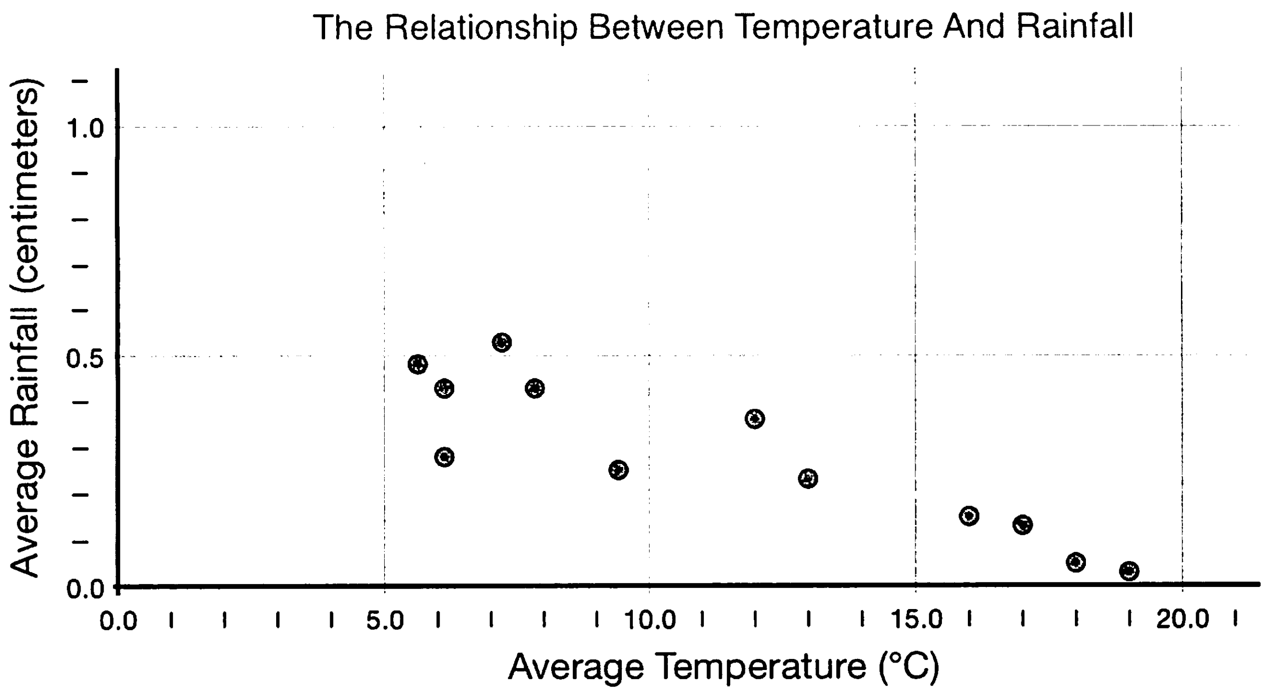
| Month | Average Temperature (2010, 2011, 2012) ± 1.0 °C | Average Rainfall (2010, 2011, 2012) ± 0.01 cm |
|---|---|---|
| January | 6.1 | 0.43 |
| February | 6.1 | 0.28 |
| March | 7.8 | 0.43 |
| April | 9.4 | 0.25 |
| May | 13 | 0.23 |
| June | 16 | 0.15 |
| July | 18 | 0.05 |
| August | 19 | 0.03 |
| September | 17 | 0.13 |
| October | 12 | 0.36 |
| November | 7.2 | 0.53 |
| December | 5.6 | 0.48 |

# The Relationship Between Temperature and Rainfall



Maximum and Minimum gradients






Line of Best Fit Equation:

Average Rainfall = -0.03 (Average Temperature) + 0.62 ± 0.005

For the following maximum and minimum line gradient calculations, the average rainfall- or y value- uncertainty values of the following points (5.6, 0.48) and (19, 0.03) are used.

Maximum Line gradient

$$\frac{0.49 - 0.02}{5.6 - 19} = \frac{0.47}{-13.4} = -0.04$$

Minimum Line gradient

$$\frac{0.47 - 0.04}{5.6 - 19} = \frac{0.43}{-13.4} \approx -0.03$$

Uncertainty of Line of Best Fit Equation:

$$\frac{\textit{max gradient} - \textit{min gradient}}{2} = \frac{-0.04 - (-0.03)}{2} = \frac{-0.01}{2} = 0.005$$

Conclusion

The graph shows a negative relationship between temperature and rainfall as the graph has a negative slope for the line of best fit. Thus, as the average temperature increases, the average amount of rainfall decreases. However, the gradient of the line of best fit is significantly close to zero, making the relationship weak.

The reason the b value on the line of best fit cannot be ignored is because there is no zero value, or start temperature, rather, for average temperature. For this reason, the relationship between temperature and rainfall cannot be proportional because it lacks this necessary factor of proportional values, as it must go through the origin to be proportional.

Additionally, significant figures may have impacted the results as both average temperature and average rainfall values were manipulated to coincide with each allotted number of significant figures. In effect, values are restricted and the plotted data is likely less precise than its potential.

As I did not collect the values myself, I cannot speak to any systematic or random errors that may have occurred in the data collection process.

Evaluation

| Source of Error | Realistic Improvement |
|---|---|
| The values I retrieved were rounded averages of the given measurements which could have negatively affected the data, preventing it from being its maximum potential | Search for more precise measurements online |
| The values are averages of the city of Seattle, Washington, and could be considered too large of a target area to accurately analyze, because there are several areas within the city, | Focus the target area on a more specific/smaller area |

| | |
|---|---|
| thus generalizing the data to an even greater extent | |

Bibliography

"Historical Weather." *Weather History & Data Archive*. Weather Underground, n.d. Web. 2 April 2015.