Rachel Driehaus and Leah Gillespie
MAT 375
Dr. Long
3/2/18

Mini Project 3: Tabligbo

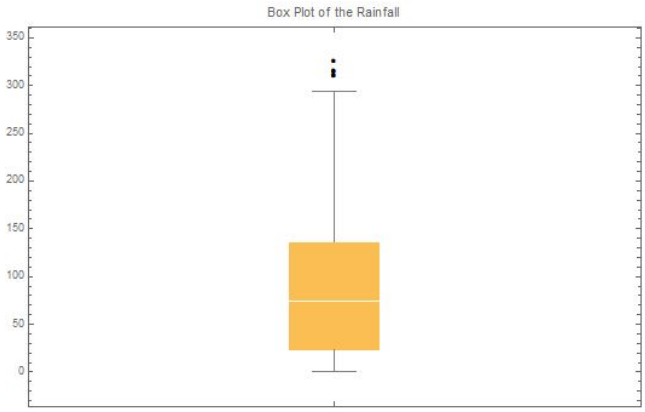
Background Information

Tabligbo is a city in the Maritime region of Togo, Africa. The Maritime region is the closest region to the Gulf of Guinea. Tabligbo has 22,304 inhabitants as of 2010 and is situated near the tropical, dry forest biome. Tabligbo has a tropical climate with the rainy season lasting from April to October. There is much less rainfall in the winter than in the summer. The annual mean temperature is 27.4 degrees celsius with the average monthly temperature varying by 3.6 degrees celsius. There was a cement plant running from 1980 to 1984. WACEM (West Africa Cement) reopened it in 1997 after several attempts with the infusion funds from an Indian company.

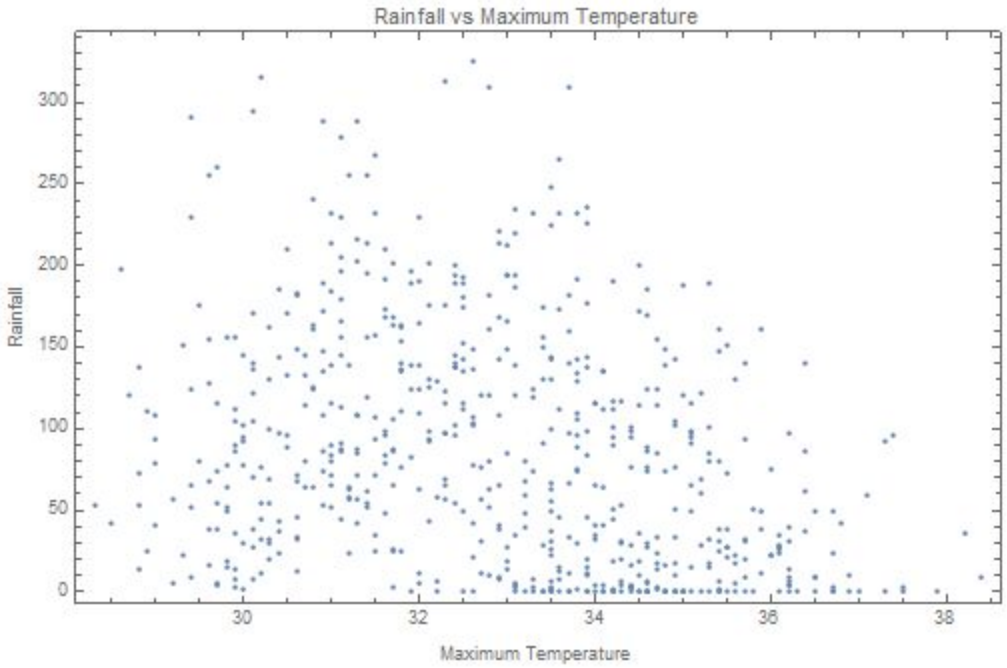
Outliers

We found our outliers by determining the interquartile range (IQR), first quartile (Q1), and third quartile (Q3) of the rainfall data. Any rainfall data that falls below $Q1 - 1.5 * IQR$ and above $Q3 + 1.5 * IQR$ is an outlier. From these equations, we found five outliers. We also made a box plot to show the outliers of the data.

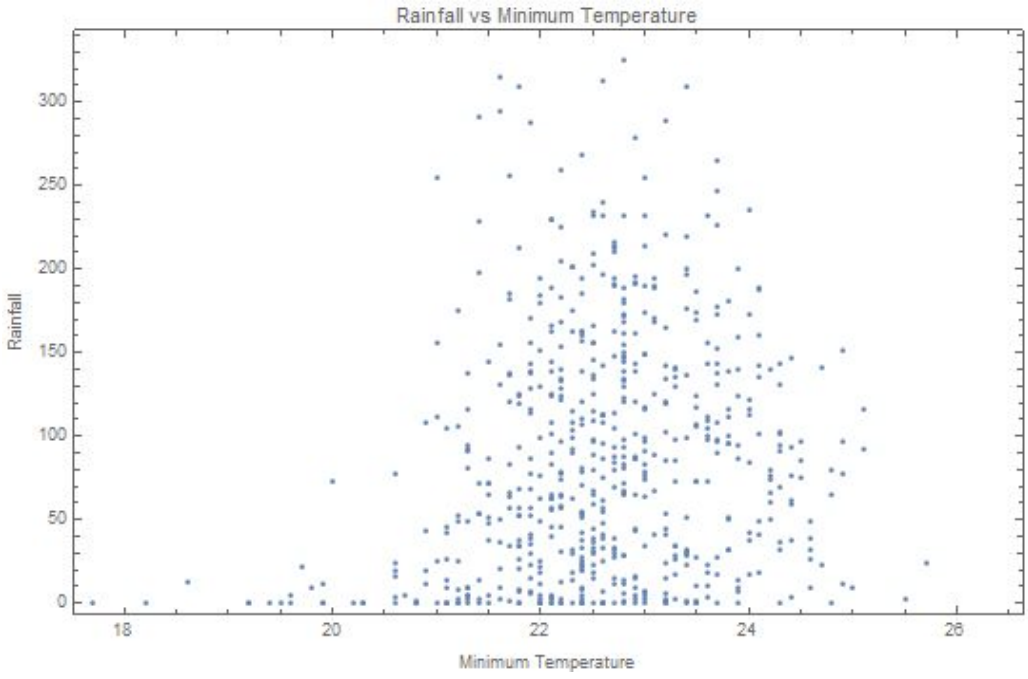
Month	Year	Rainfall
April	1965	309.8
September	1968	315.3
May	1978	325.5
March	1995	309.6
October	2002	313.3



Modeling Rainfall Data

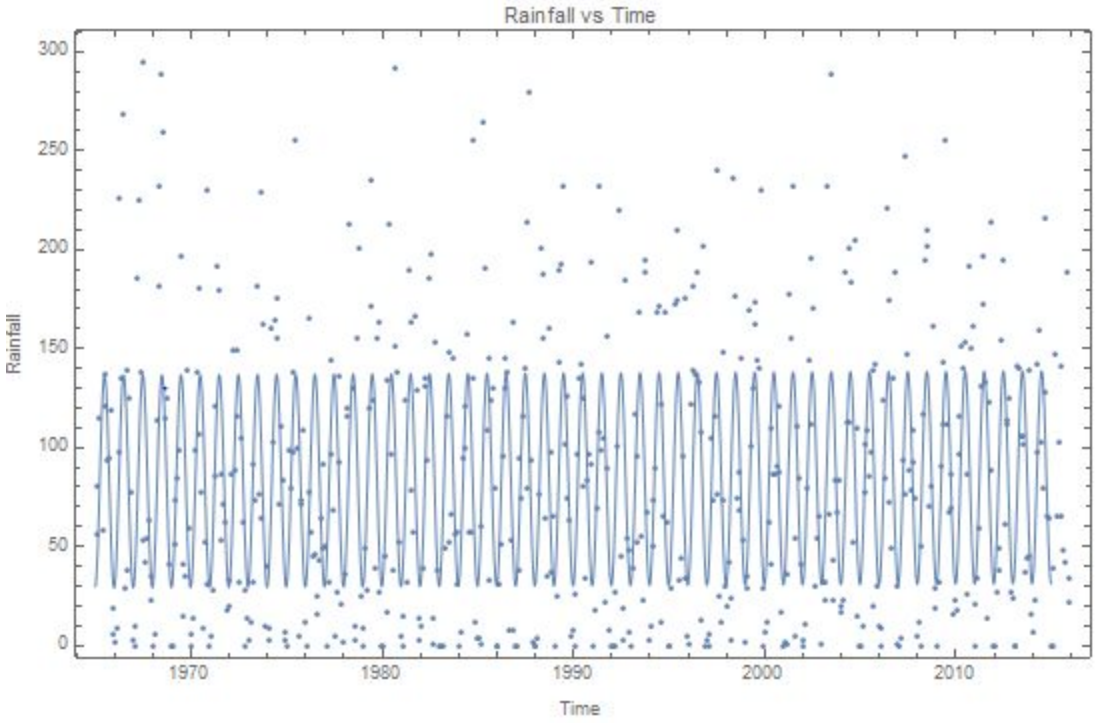


The graph above shows the Rainfall vs the Maximum Temperatures. According to this graph, it appears that there is less rainfall with the higher maximum temperatures. The graph below shows the Rain vs the Minimum Temperatures. The most rainfall is concentrated during the middle of the minimum temperatures 21 to 25 degrees Celsius. From our graphs, it appears that rainfall has somewhat of an effect on the maximum and minimum temperatures.



The equation below is the best model with the outliers taken out. We found that the linear model with Sine and Cosine was the best model for the rainfall data. We tried several models and found that the quadratic term was not significant, and the other sets of Sine and Cosine terms also did not appear to be significant.

$$y = -2.07605 + 0.0432147x - 53.2042Cos(2\pi x) + 8.30643Sin(2\pi x)$$



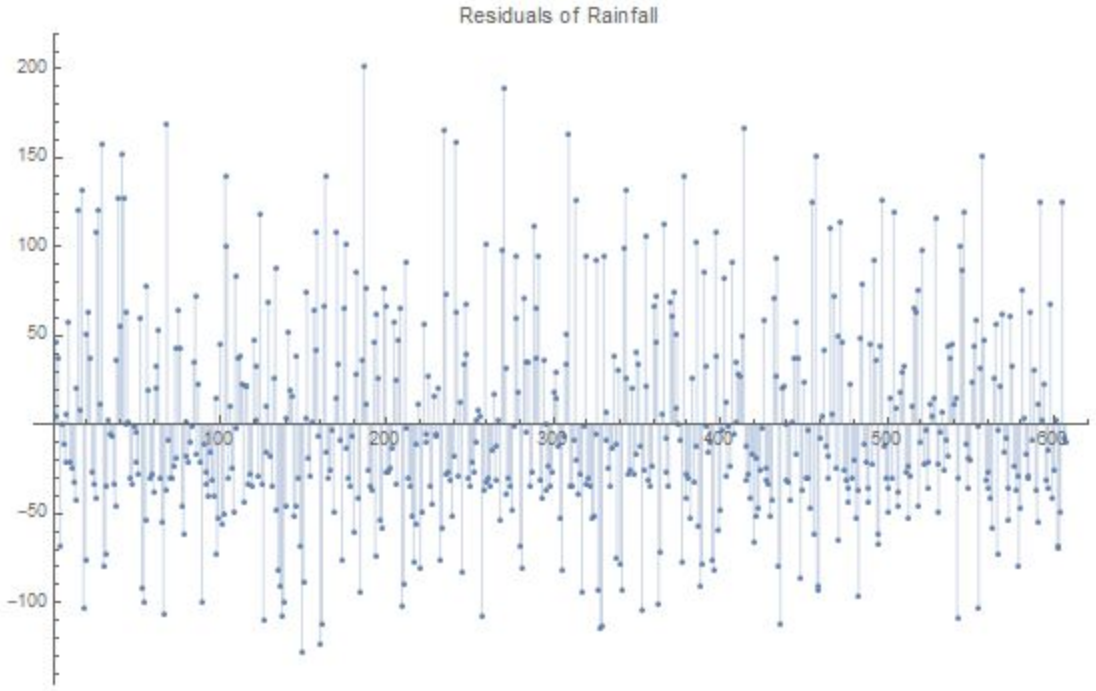
	Estimate	Standard Error	t- Statistic	P- Value
1	−2.07605	320.	−0.00648767	0.994826
x	0.0432147	0.160754	0.268826	0.788156
Sin[2 π x]	8.30643	3.35208	2.478	0.0134849
Cos[2 π x]	−53.2042	3.33281	−15.9638	4.13787×10^{-48}

Both the Sine and Cosine are significant. X is not significant, but we cannot throw it out because this is a hierarchical model.

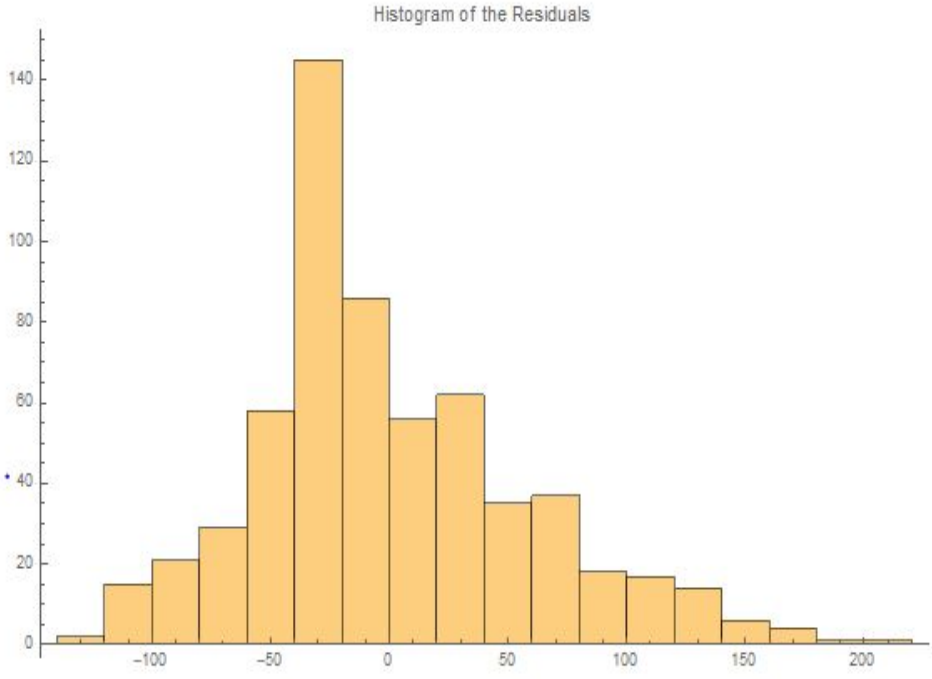
$$R^2 = 0.302041$$

The R-squared is very low, which not the best. The R-Squared did improve slightly by 0.0194024 after we took out the outliers. We are not sure how to improve the model to make the

R-squared better. The data is extremely spread out, as you can see in the graph above, which makes it hard to create a model that incorporates every data point, and it also makes an impact on R-squared.

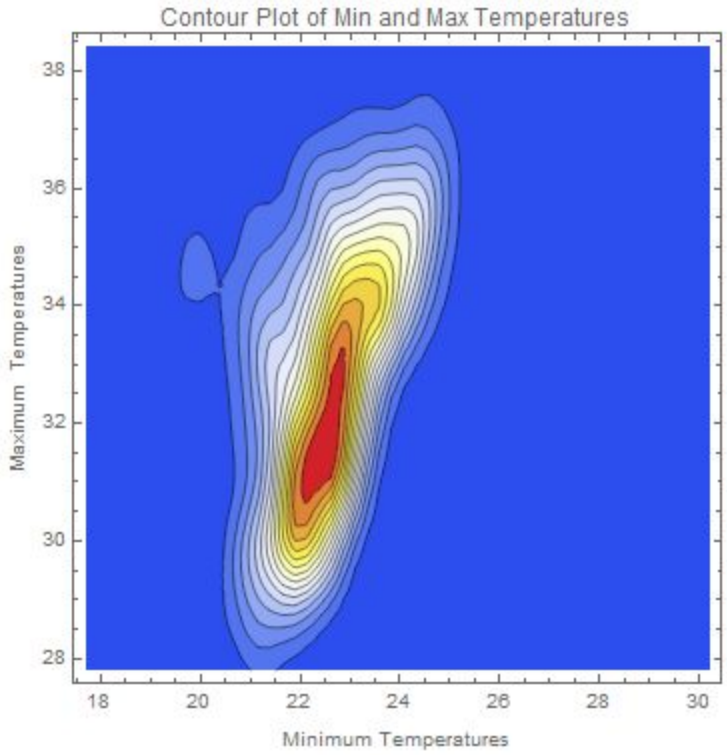


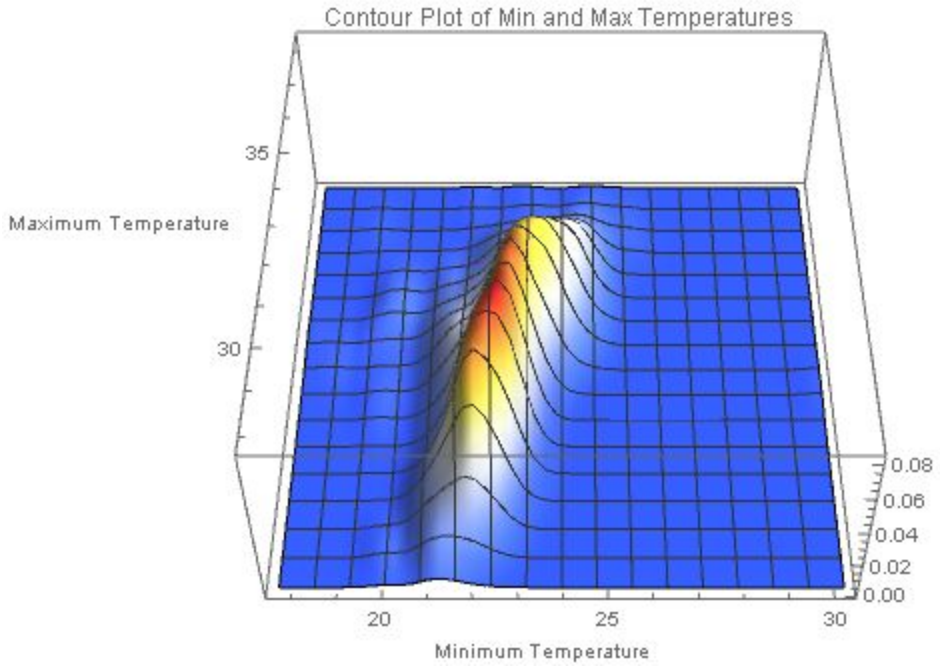
The residuals look fairly scattered, and there does not appear a definite pattern.



The histogram of the residuals is asymmetrical and does not have a normal distribution. The histogram is skewed to the right.

Modeling Maximum and Minimum Temperatures





These two plots show the same thing. One is 2D and the other is in 3D. The contour plot of the temperatures show that the the more red the area is the more points fall into that area. The bluer the area is the less amount of points there are in the area. Most of our data falls into about 22 degrees for the minimum temperature and between 31 and 33 degrees for the maximum temperature.

Conclusion

We found that there is no evidence of either an increase or decrease in the rainfall of the city of Tabligbo. For next time, we might look at including temperature in the model, but as of right now we could not figure out how to do that using Mathematica. We did notice that there were 50 zeros in our rainfall data, which not necessarily good. However, the 50 zeros were to be expected because there are rainy and dry seasons in Tabligbo.

Moving forward, we would like to know more information about the town in general because we found little information on it. Specifically, we would like more details about the cement/chemical plant, and whether it is active or not. If the cement/chemical plant is active, we would want to know how much production takes place at the plant. We would also like a confirmation that the rainfall is in millimeters and not centimeters.