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Mini-Project #3

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Sokode

Sokode is the second largest city in Togo. Located in a gap of mountains, it’s latitude is 1.13 and longitude is 8.98. The population is approximately 113,000 people. The climate there is tropical with two distinct seasons: wet and dry. The dry season lasts from November to March. The rainy season lasts from April to October where the number of rainy days varies between 100 and 130. The average rainfall per year is between 1,200 and 1,500 mm. The average altitude in Sokode is 340 meters. On average the warmest month is April, the coolest month is December, the wettest month is October, and the driest is September.



2) From the work done for Mini-Project #1 and #2, we can say that the minimum and the maximum temperature for Sokode are significantly rising with time. We would like to explore what is happening to rainfall in Sokode with time.

3) To determine outliers, we looked at the mean and standard deviation. From this calculation, we determined that there is no need to eliminate outliers. This was supported by eyeballing the data and coming to the same conclusion. There are some data points that are significantly higher than others, but rainfall can change drastically from year to year so we find it acceptable to keep all data points.

4) We found that rainfall does not vary over time. Our model is:






We used pairs of Sin and Cos terms with different periods. The periods that we used are for one year, one-half year, one-third year, and one-fourth year. We do not find evidence of significant increase or decrease of rainfall with time. The model does dip—it looks like it is oscillating and appears somewhat wave-like. The residuals appear random and independent. The histogram is not as normal as we would like to see—it is too skinny.

All of the terms are significant except for Sin [2\*Pi\*x/.3333] and Sin [2\*Pi\*x/.25] (their p-values are .45 and .49, respectively, which are too high). But, we kept those terms because the Cosine term for those periods is significant. The R-Squared value is .76 which is not as good as we would like, but it is not terrible.

The model and residuals for the minimum temperature are:







As time goes on, minimum temperature is clearly increasing. This conclusion was reached by the first two mini-projects for Sokode and we support that conclusion.

The model for the maximum temperature is:







The residuals are random and independent. The histogram is not as normal as we would like--there is a "shrug" to the left. From the model, it is clear that temperature is increasing.

In our Mathematica code, we used the manipulate command so that we can closely look at the models for rainfall, minimum temperature, and maximum temperature. From the rainfall model, rainfall certainly appears to not be increasing. In fact, there may be a slight decrease in rainfall. As time goes on, the model slightly decreases.

You can also see 3D plots and other interactive plots in our Mathematica code.

8) After completing the work for this project, we still have a few questions. We still want to know how the temperature data was collected. Was the temperature taken at the same location and same time every day? We have the same questions for the rainfall measurements: how were these taken? With what instruments did they collect this data, and how often? Did they obtain the measurements at the same location every time? If so, where? Also, we are curious about the drastic differences in rainfall amounts within each month. For example, January was made up of mostly 0.0 mm of rainfall, but had about 6 data points that were considerably higher. Although rainfall is unpredictable, this data was curious. But since there were several strange data points, we did not feel comfortable throwing them out. We determined that we would keep them in the data set. Also, because of the dipping in our model, we thought we were seeing a slight wave-like essence to our rainfall data. Is there anything that would be causing this that the Togolese know of?

**Citations:**

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