FINAL PROJECT AIT-580

Analytics: Big Data to Information

JASWANTH ERUSU

*GEORGE MASON UIVERSITY*

*FALL-2022*

[JERUSU@GMU.EDU](mailto:JERUSU@GMU.EDU)

**Abstract—The US weather dataset is made up of climate-related data from Data World. The information pertains to the environment. This dataset contains information on the climate of United States and its cities. This collection offers a diverse set of information. Weather forecasting is meteorologists' attempt to anticipate weather conditions in the future and weather circumstances that may be predicted. The climatic condition characteristics are determined by the temperature, wind, humidity, rainfall, and data set size. Only temperature and humidity are included for experimental analysis in this case. This is used to evaluate data, Python, and R-Studio tools to generate intelligible results. I observed through big datasets that there is a lot of variation in climatic changes based on longitude and latitude. Visualizations and summary statistics are created using Python and R.**

**Keywords—**

**Mean distance, temperature’s, least-squares regression, Outliers, and Influential Observations, Residuals**

**Introduction—Without a doubt, global change has become one of the issues that includes a wide spectrum of human existence, including social and economic elements. According to research, climate change will continue to influence the planet if effective environmental protection. Measures are not implemented. I took a data set from the data world website that is related to weather and changes over the last 25 years. It consists of data columns like minimum temperature, maximum temperature, station names, and so on. I created virilizations in python, and on the other hand, I have return quires in SQL for sorting out the data using the above data set.** **Weather forecasting is a complex and difficult task. The procedure is divided into three steps: observation, analysis, and communication. Forecasters use atmospheric models to make observations. These are equation sets that depict the condition of the atmosphere. To forecast weather, models employ information about the beginning condition (observations) of the atmosphere, land, and ocean. Data from the models is coupled with information from weather stations placed at strategic locations around an area or country to provide an accurate picture of the status of the atmosphere. Because it improves forecasters' understanding of the dynamic weather system, data assimilation generates a better prediction.** **It is simpler to be correct when providing a short-term forecast (hours to days) than when evaluating long-term data (months or seasons). The atmospheric system is dynamic; as time passes, forecasters might become less certain of its status.**

**Technological advancements have significantly increased the overall accuracy of weather forecasting. For example, automated weather stations allow for more observations. High speed computers is also becoming more popular. This enables for larger data storage, as well as faster data processing, analysis, and visualization.**

**NOIR DATA TYPES: (World, 2017) (UCI, 2016)**

|  |  |  |
| --- | --- | --- |
| Column Name | Description | NOIR  Data Type |
| date\_str | DATE  OF OBSERVATION | **INTERVAL** |
| degrees\_from\_mean | MEAN DISTANCE | **RATIO** |
| Id | EXPECTED TO BE CITY CODE | **INTERVAL** |
| Longitude and latitude | EXACT LOCATION OF THE CITY | **ORDINAL** |
| max\_temp and min\_temp | TEMPERATURE’S | **INTERVAL** |
| station\_name | CITY NAME | **NOMINAL** |
| Type | CLIMATIC CONDITIONS | **ORDINAL** |

**Literature Review—In this internet era, one is surrounded by a digital world with a richness of knowledge. It is increasingly simple to gather ideas or feelings on a topic, such as software, a product, movies, music, or novels. Opinion mining refers to computational methodologies for extracting, categorizing, evaluating, and interpreting views expressed in different online news sources, social media comments, and other user-generated data. It falls under the umbrella of data mining and computational linguistics. Sentiment analysis is commonly used in opinion mining to assess sentiment, affect, subjectivity, and other emotional states in online discussions. Sentiment research has caught the attention of the financial industry. Climate forecasting organizations can employ AI-powered sentiment analysis tools to gauge weather perceptions and climatic image.**

**The climate dataset I've been working on is from data world. because it comprises information on minimum and maximum temperatures as well as longitudes, latitudes, dates, cities, meteorological conditions, and so on. This dataset's data is tied to a weather forecasting agency in the United States. The location condition is used to collect data for the marketing campaign.**

**Research Questions—**

**1. Analysing the co-relation between all numeric variables in the dataset?**

**2. What is the maximum number of campaigns that can be conducted to achieve a favourable response from the location? Out of the favourable outcome how many locations have been living conditions?**

**3. Effects of minimum and maximum temperatures?**

**4. Effects of degree from mean and how important it is?**

**5. Does the effect of temperature directly or indirectly effects the location of the city and population growth?**

**Data Set—**

**Table

Description automatically generated**

**Diagram [1]**

**This is the data set after making it cleaning by using excel. For the better visualization I have cut down the data from original data set.**

**Descriptive Evaluation—**

**Initially, we import the csv file and partition the attributes depending on their characteristics, such as category and integer attributes. This approach will also assist with validation, testing, and training. We later find all of the statistical data for each integer column. Later, we obtain variables such as the count, unique values, top value, and frequency for each column of category qualities.**

**Analysis of Missing Values—**

**This Missing Value analysis will determine whether the data collection contains null values (values that are not numbers). If any null values exist for further processing, they must be replaced. In our scenario, there are no null values in the specified data fields.**

**Data cleaning—**

**The climate data set I chose comprises 34 rows and 10 columns. I used Excel and Python to tidy up the data.**

**First, I examined the entire dataset for null values and found none in this dataset. There were ten columns before the data was removed, and the default column was not utilized for data cleaning. So, I cleaned it up by eliminating the entire column. I obtained summary statistics and visualizations from my data by utilizing Python, R, and SQL tools to generate numerous conclusions and insights, which will be beneficial in examining various components of my dataset. (UCI, 2016)**

**Visualization in Python**

**Text

Description automatically generated with medium confidence**

**Diagram [2]**

**Here is the dataset after loading the data in Spyder ide**

**Text

Description automatically generated**

****

**Diagram [3]**

**Here is the dataset after selecting the only two data from the entire dataset from here to extracting data visualization.**

**Text

Description automatically generated**

**Diagram [4]**

**Here is the dataset after selecting the only two data from the entire dataset.**

**Text

Description automatically generated**

**Diagram [5]**

**The above code is to represent the line graph by using the matplotlib library in python which is to determine the maximum temperatures in different cities.**

Chart, line chart

Description automatically generated

**Diagram [6]**

**By executing the diagram [5] in python ide we got a representation like above.**

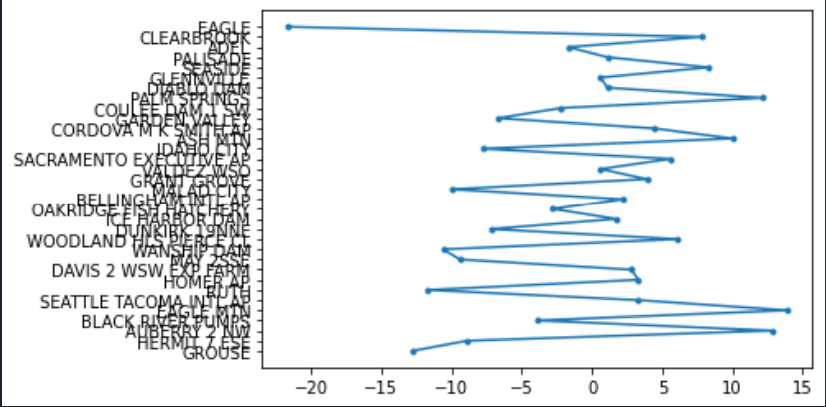
**Observing the diagram, we can see that there is maximum temperature on the x axis and cities on the y axis. The above graph makes it extremely simple to represent the data.**

**Text

Description automatically generated**

**Diagram [7]**

**The above code is to represent the line graph by using the matplotlib library in python which is to determine the minimum temperatures in different cities.**



**Diagram [8]**

**By executing the diagram [6] in python ide we got a representation like above.**

**Observing the diagram, we can see that there is minimum temperature on the x axis and cities on the y axis. The above graph makes it extremely simple to represent the data.**

**Visualization in R language**

**ggplot2 is a system for declaratively creating graphics, based on The Grammar of Graphics. You provide the data, tell ggplot2 how to map variables to aesthetics, what graphical primitives to use, and it takes care of the details.**

**It’s hard to succinctly describe how ggplot2 works because it embodies a deep philosophy of visualisation. However, in most cases you start with ggplot (), supply a dataset and aesthetic mapping (with aes ()). You then add on layers (like geom\_point () or geom\_histogram ()), scales (like scale\_colour\_brewer ()), faceting specifications (like facet wrap()) and coordinate systems (like coord\_flip()).**

**Text

Description automatically generated**

**Diagram [8]**

**Above picture is reference for the libraries which I have used for executing of the below codes.**

**Text

Description automatically generated**

**Diagram [9]**

**The above code is to represent the point graph by using the ggplot in r language which is to determine the climatic conditions in different cities.**

**3. Effects of minimum and maximum temperatures?**

**Graphical user interface, application, table

Description automatically generated**

**Diagram [10]**

**By observing the diagram, we can see that there are station names on the x axis and the type of climatic conditions in different city on the y axis. The above graph makes easy to understand the data well.**

**Text

Description automatically generated**

**Diagram [11]**

**The above code is to represent the point graph by using the ggplot in r language which is to determine the climatic conditions in different cities.**

**2. What is the maximum number of campaigns that can be conducted to achieve a favourable response from the location? Out of the favourable outcome how many locations have been living conditions?**

**Chart, scatter chart

Description automatically generated**

**Diagram [12]**

**We can see from the diagram that there are station names on the x axis and latitude on the y axis. The preceding graph makes the geographical position of the city easier to grasp, which is why I displayed the data; on the left side of the plot, I have mentioned the range where it speaks about the location. When it is red, it is generally in the south of the nation, where there are extremely little chances of snowfall. When it is green, it is generally in the north of the nation.**

**Text

Description automatically generated**

**Diagram [13]**

**The above code is to represent the point graph by using the ggplot in r language which is to determine the climatic conditions in different cities.**

**2. What is the maximum number of campaigns that can be conducted to achieve a favourable response from the location? Out of the favourable outcome how many locations have been living conditions?**

**Chart, scatter chart

Description automatically generated**

**Diagram [14]**

**We can see from the diagram that there are station names on the x axis and longitude on the y axis. The preceding graph makes the geographical position of the city easier to grasp, which is why I displayed the data; on the left side of the plot, I have mentioned the range where it speaks about the location. When it is red, it is generally in the north of the nation, where there are extremely little chances of snowfall. When it is green, it is generally in the south of the nation, and it is snow free place.**

**Text

Description automatically generated**

**Diagram [15]**

**The above code is to represent the point graph by using the ggplot in r language which is to determine the climatic conditions like maximum temperature in different cities.**

**Chart, scatter chart

Description automatically generated**

**Diagram [16]**

**We can see from the diagram that there are station names on the x axis and longitude on the y axis. The preceding graph makes the geographical position of the city easier to grasp, which is why I displayed the data; on the left side of the plot, I have mentioned the range where it speaks about the temperature. When it is red, it is generally in the south of the nation generally towards the equator, where there are extremely little chances of snowfall. When it is green, it is generally in the north of the nation, where there is very high chances of having coolness in these regions.**

**Text

Description automatically generated**

**Diagram [17]**

**The above code is to represent the point graph by using the ggplot in r language which is to determine the climatic conditions like minimum temperature in different cities.**

**A picture containing chart

Description automatically generated**

**Diagram [18]**

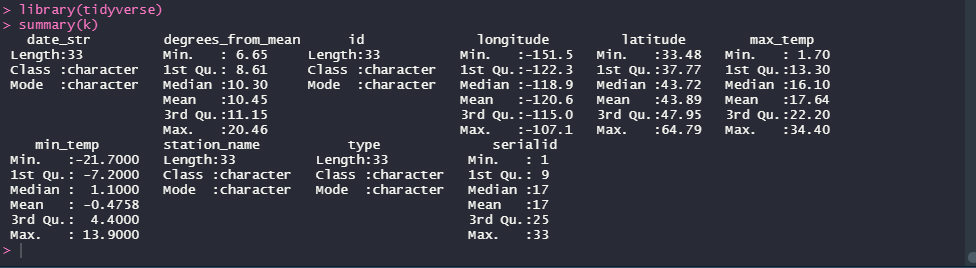
**We can see from the diagram that there are station names on the x axis and longitude on the y axis. The preceding graph makes the geographical position of the city easier to grasp, which is why I displayed the data; on the left side of the plot, I have mentioned the range where it speaks about the temperature. When it is green, it is generally in the south of the nation generally towards the equator, where there are extremely little chances of snowfall. When it is red, it is generally in the north of the nation, where there is very high chances of having snow fall in this regions.**

**Shape

Description automatically generated with medium confidence**

**Diagram [19]**

**To obtain the summary of a Data Frame, use the summary () function and supply the Data Frame as an argument. We can supply extra options to summary () that influence the output of the summary.**

****

**Diagram [20]**

**The summary () function returns a summary for each column. If the column is of the numerical kind, the summary will include information such as minimum, maximum, median, mean, and so on. If the column is of the char type, the summary would include information such as length, class, and mode.**

**Linear Regression**

**Regression analysis is a popular statistical technique for establishing a connection model between two variables. One of these variables is known as a predictor variable, and its value is determined through studies. The other variable is known as the response variable, and its value is determined by the predictor variable.**

**In Linear Regression, these two variables are linked by an equation in which the exponent (power) of both variables is 1. When represented as a graph, a linear connection reflects a straight line mathematically. A curve is formed by a non-linear connection in which the exponent of any variable is greater than one.**

**The equation y = c + b\*x defines the easiest version of the regression model with one reliant and one outcome variable, where y = estimated dependent variable score, c = constant, b = regression coefficient, and x = exogenous variables score.**

**Function lm ()**

**This function constructs the model of the connection between the predictor and the response variable.**

**Text

Description automatically generated**

**Diagram [21]**

**Residuals**

**After fitting a regression model to a set of data, the modeler can test the validity of his or her assumption that a linear connection exists by examining the residuals (the deviations from the fitted line to the observed values). Plotting the residuals on the y-axis versus the explanatory variable on the x-axis indicates any possible non-linear connection between the variables and may prompt the modeler to look for hidden variables. The residual plot in our case magnifies the presence of outliers.**

**1. Analysing the co-relation between all numeric variables in the dataset?**

**Chart, scatter chart

Description automatically generated**

**Diagram [22]**

**Least-Squares Regression**

**The least-squares approach is the most often used method for fitting a regression line. The best-fitting line for the observed data is determined by minimizing the sum of the squares of the vertical deviations from each data point to the line (if a point lies on the fitted line exactly, then its vertical deviation is 0). There are no cancellations between positive and negative numbers since the deviations are first squared and then totalled.**

**Outliers and Influential Observations**

**After a regression line has been constructed for a set of data, an outlier is a point that is distant off the line (and so has a significant residual value). Such points may signify incorrect data or a poorly fitted regression line. An important observation is one that is located far away from the other data in the horizontal direction. This difference is made because these points could have a considerable influence on the slope of the regression line.**

**Text

Description automatically generated**

**Diagram [23]**

**Plotting out the degree of mean vs type in box plot so that there would be better understand by all**

**4. Effects of degree from mean and how important it is?**

**Chart, box and whisker chart

Description automatically generated**

**Diagram [24]**

**Boxplots are a type of data visualization that shows summary statistics for your data.**

**Chart, diagram, box and whisker chart

Description automatically generated**

**Diagram [25]**

**More specifically, boxplots visualize what we call the “five number summary.” The five number summary is a set of values that includes: the minimum, the first quartile (25th percentile), the median, the third quartile (75th percentile), the maximum**

**SQL Operations:**

**1. Import the dataset file into new schema:**

**Naming this table ‘ait\_final\_project’ and loading the dataset into new schema.**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project;**

**OUTPUT:**

**Graphical user interface, text, application, table

Description automatically generated**

**Diagram [26]**

**As shown in the above output about the data**

**2) #SELECTING THE GRID**

**INPUT:**

**SELECT degrees\_from\_mean FROM ait\_final\_project. Ait\_final\_project.**

**OUTPUT:**

**Graphical user interface, text, application, Word

Description automatically generated**

**Diagram [27]**

**As shown in the above output about the specific data**

**3) #FILTER THE VALUES WHICH IS ABOVE 10.00 IN degrees\_from\_mean**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**WHERE degrees\_from\_mean>10**

**ORDER BY degrees\_from\_mean DESC**

**OUTPUT:**

**Graphical user interface, table

Description automatically generated**

**Diagram [28]**

**As shown in the above output about the specific data called degree from mean which is above 10 and high. Where I have given instruction decrease from highest to lowest**

**4) #FOR THE STATION I WANT**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**WHERE station\_name='BLACK RIVER PUMPS' OR station\_name='ICE HARBOR DAM’.**

**OUTPUT:**

**Graphical user interface, text, application, email

Description automatically generated**

**Diagram [29]**

**As shown in the above output about the specific data and selecting the specific stations. Where I am interested in finding out.**

**5)** **#SELECTING STATION NAME WHICH IS HAVING B IN STARTING**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**WHERE station\_name like'B%’.**

**OUTPUT:**

**Graphical user interface, text, application

Description automatically generated**

**Diagram [30]**

**As shown in the above output about the specific data and selecting the specific stations which is having specific alphabet ‘B’ as first alphabet. Where I am interested in finding out.**

**6) #SELECTING STATION NAME WHICH IS HAVING K ANYWHERE**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**WHERE station\_name like'%K%’.**

**OUTPUT:**

**Graphical user interface, text, application, email

Description automatically generated**

**As shown in the above output about the specific data and selecting the specific stations which is having specific alphabet ‘k’ anywhere in the word. Where I am interested in finding out.**

**7)** **# MAX TEMP MAXIMUM**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**ORDER BY max\_temp DESC.**

**OUTPUT:**

**Graphical user interface, application, table

Description automatically generated**

**As shown in the above output about the specific data called maximum temperature and passing out order by decrease, so that there is in arrange in descending order.**

**8)** **#MIN TEMP MAXIMUM**

**INPUT:**

**SELECT \* FROM ait\_final\_project. Ait\_final\_project**

**ORDER BY min\_temp ASC.**

**OUTPUT:**

**Graphical user interface, application, table

Description automatically generated**

**As shown in the above output about the specific data called minimum temperature and passing out order by decrease, so that there is in arrange in descending order.**

**Limitations (The Challenges and Complexities of Weather Forecasting):**

**Weather forecasting is a sophisticated and frequently difficult skill that requires huge amounts of data to be seen and processed. Weather systems may range in size from small, short-lived thunderstorms a few miles in diameter that last a few hours to large-scale rain and snow thunderstorms a thousand miles in diameter that continue for days.**

**Forecasting is essentially a three-step procedure. These are some examples:**

**1) Observation**

**2) Prediction**

**3) Interaction.**

**When a forecaster arrives on the job, the first thing they do is learn about the present weather conditions. This involves reviewing satellite imagery, surface data, precipitation reports, and hearing from other forecasters on duty. The next step is to anticipate weather changes by projecting them into the future. Short-term forecasting, looking a few hours ahead, often relies on closely watching and following how weather systems are changing and tracking, and projecting their movement into the future based on what is known about atmospheric dynamics. Beyond-day forecasts rely heavily on numerical weather modelling.** **Numerical forecast models use data from surface observations, weather balloons, and satellite photos to build a computer-generated prediction of future weather. The dynamic equations used in the model simulations indicate how the atmosphere will respond to variations in temperature, pressure, and humidity over time. Forecasters must choose which forecast models to depend on based on how well they appear to be managing current weather, how realistic their output is, and how consistent the prediction models are from one run to the next. At such point, the forecaster may determine that no model can be depended on.** **Once forecasters have generated a forecast that they are relatively confident in, their next task is to present that forecast in a fashion that people can comprehend and respond to properly. The National Weather Service's objective is to disseminate predictions in a way that saves lives and protects property. When a meteorological event has the potential to hit our forecast region, a weather watch, such as a winter storm watch, a high wind watch, or a thunderstorm watch, will be issued. When a watch is issued, those who may be affected should pay close attention to updated forecasts for potential warnings.** **A weather warning indicates that the predicted occurrence is imminent, and people in the affected region should prepare. National Weather Service warnings sometimes contain "call to action" remarks in which the public is advised on how to prepare for the impending weather. Following a big weather event, forecasters will contact weather spotters across their prediction region to determine the effect of the weather event. They will collect data on how much rain or snow fell and whether any weather-related damage happened. Forecasters can learn how successfully their forecast was confirmed as well as what unexpected events occurred by assessing the effect of an event, allowing them to improve future forecasts.**

**Future Scope:**

**Actual weather forecasting is essential in agriculture. Farmers, for example, utilize meteorological data to determine how they should operate, staff, harvest, mitigate, and so on, which presents a dilemma. Furthermore, intelligent planting efforts will assist in the timing of plant development and reproduction to prevent cold. Frost forecasting and prediction is an important component of agricultural weather forecasting. Frost may have a significant impact on plant structure, reproduction, and the financial health of a farm (through harvest yield). Avoiding seasonal extremes can help farmers save money and result in more lucrative output and farm management. Weather forecasting is only one component of Smart Farming. Aside from weather, the method makes use of technology and geographical data sources to give more context than traditional forecasting.**

**Conclusion:**

**How Weather forecasting is important?**

**1. Tourism advantages from weather forecasting**

**Without a question, climate and weather have a significant impact on tourism. Weather changes may have an impact on travellers and tourism enterprises. Thus, weather forecasting aids in the development of tourism facilities to reduce the damage caused by severe weather while increasing revenue. Tourists may pick appropriate sites for the greatest experience and organize their visits to prevent any problems by checking weather predictions. The significance of weather forecasting cannot be overstated.**

**2. Forecasting the weather increases transportation safety.**

**Weather has a significant influence on road safety and operation. Severe weather conditions, such as snow, rain, or a storm, might affect driving ability. Furthermore, there have been a flurry of road incidents that have been attributed to adverse weather. Weather forecasts assist in reducing airline delays, flying times, and energy savings, as well as ensuring passenger safety and comfort. The primary significance of weather forecasting for this business is the information supplied on important weather conditions that might harm an aircraft during take-off, landing, and flight, such as strong winds, thunderstorms, tornadoes, and ice.**

**3. Weather forecasting is useful for clothing.**

**It's true that the weather influences how we dress. Even if you have a large wardrobe, dressing appropriately in different weather circumstances is difficult. For example, suppose you have an outside meeting tomorrow and don't know how to dress appropriately. This is where weather forecasts may help. By evaluating whether you can obtain an idea of how the weather will be before the event, you can pick the ideal apparel without being influenced by the weather. This saves you time and eliminates the hassle of deciding what to wear.**

**4. Farmers benefit from weather predictions.**

**Temperature, humidity, and precipitation all play vital roles in fruit and vegetable production. Farmers used to forecast the weather based on observations of the sky. However, the advancement of meteorology in recent years has equipped them with reliable weather forecasts by collecting data utilizing supercomputers. Farmers may better understand and follow crop growth status by reviewing weather forecasts on a regular basis, allowing them to make potentially costly decisions. The significance of weather forecasting for precision agriculture is self-evident.**

**5.Weather forecasting allows for effective planning.**

**Making suitable planning is one of the most obvious advantages of weather forecasting. Checking weather predictions online before a vacation or before participating in outdoor activities to know what the weather will be like and to be prepared.**

**6.Forestry and weather forecasting**

**Weather forecasting is critical for wildfire prevention and control. To anticipate regions prone to fire, many indicators, such as the Forest Fire Weather Index and the Haines Index, have been established. The path of the weather can also be used to forecast insect growth conditions.**

# References

|  |  |
| --- | --- |
| [1] | Tech Target, “Big Data,” [Online]. Available: https://www.techtarget.com/searchdatamanagement/definition/big-data. |
| [2] | J.-F. Bastin. [Online]. Available: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217592. |
| [3] | L. Kemp. [Online]. Available: https://www.pnas.org/doi/10.1073/pnas.2108146119. |
| [4] | D. L. Lindsay R, “Lindsay R, Dahlman L. Climate Change: Global Temperature. September 19, 2019.,” [Online]. Available: http://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature. |
| [5] | N. S. V. Studio, “NASA’s Scientific Visualization Studio. Graphic: Global Warming from 1880 to 2018.,” Updated February 12, 2019. [Online]. Available: https://www.jci.org/articles/view/135006. |
| [6] | B. J. Yale, “Berardelli J. Yale Climate Connections. Heat waves and climate change,” [Online]. Available: http://www.yaleclimateconnections.org/2019/06/heat-waves-and-climate-change-is-there-a-connection. |

# Works Cited

|  |  |
| --- | --- |
| [1] | Tech Target, “Big Data,” [Online]. Available: https://www.techtarget.com/searchdatamanagement/definition/big-data. |
| [2] | J.-F. Bastin. [Online]. Available: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217592. |
| [3] | L. Kemp. [Online]. Available: https://www.pnas.org/doi/10.1073/pnas.2108146119. |
| [4] | D. L. Lindsay R, “Lindsay R, Dahlman L. Climate Change: Global Temperature. September 19, 2019.,” [Online]. Available: http://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature. |
| [5] | N. S. V. Studio, “NASA’s Scientific Visualization Studio. Graphic: Global Warming from 1880 to 2018.,” Updated February 12, 2019. [Online]. Available: https://www.jci.org/articles/view/135006. |
| [6] | B. J. Yale, “Berardelli J. Yale Climate Connections. Heat waves and climate change,” [Online]. Available: http://www.yaleclimateconnections.org/2019/06/heat-waves-and-climate-change-is-there-a-connection. |

# Bibliography

|  |  |
| --- | --- |
| [1] | Tech Target, “Big Data,” [Online]. Available: https://www.techtarget.com/searchdatamanagement/definition/big-data. |
| [2] | J.-F. Bastin. [Online]. Available: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217592. |
| [3] | L. Kemp. [Online]. Available: https://www.pnas.org/doi/10.1073/pnas.2108146119. |
| [4] | D. L. Lindsay R, “Lindsay R, Dahlman L. Climate Change: Global Temperature. September 19, 2019.,” [Online]. Available: http://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature. |
| [5] | N. S. V. Studio, “NASA’s Scientific Visualization Studio. Graphic: Global Warming from 1880 to 2018.,” Updated February 12, 2019. [Online]. Available: https://www.jci.org/articles/view/135006. |
| [6] | B. J. Yale, “Berardelli J. Yale Climate Connections. Heat waves and climate change,” [Online]. Available: http://www.yaleclimateconnections.org/2019/06/heat-waves-and-climate-change-is-there-a-connection. |