EXPLORE WEATHER TRENDS

Submitted By
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DECLARATION

I hereby declare that the work presented in this project proposal entitled ‘Explore Weather Trends’ submitted towards completion of the Nanodegree Data Analyst program at Udacity is an authentic record of my original work. The project will be done in full compliance with the requirements of the prescribed coursework.

Zeba Azfar

Place: Seattle
Date: April 15, 2018

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FOREWORD

Objective:

To analyze the local and global temperature data, and compare the temperature trends where you live to overall global temperature trends.

Brief Introduction:

To compute the global temperature and understand the trends every month scientists combine measurements from the earth's land and ocean surfaces. Yearly average is calculated and then a long-time average or a reference value for a time period of 30 years is computed which is then used to identify 'anomalies'.

A temperature 'anomaly' is defined as a departure from a reference value or long time average which is considered normal for a region. This helps in evaluating the changes in temperature and its effects.

A 'positive anomaly' indicates that the temperature for that region is higher than the reference value and hence its warmer while a 'negative anomaly' implies that its cooler.

To assess global temperature, scientists use four major datasets:

- HadCRUT4 by UK Met Office and the University of Anglia
- GISTEMP by NASA
- MLSOT by National Oceanic Atmospheric Association
- Japan Meteorological Agency

Reasons for considering 'anomalies' and not absolute temperature:

- Lack of presence of stations in some regions due to which the data for those regions are not available and scientists use interpolation to estimate values.
- A baseline is established by computing a reference value for the same time period which normalizes(adjust values to align distributions) the data to be compared and combined to represent more accurate patterns w.r.t what is normal for different places within a region.
- Changes in instrumentation methods and measurement errors.

PROBLEM DEFINITION

Create a visualization and prepare a write up describing the similarities and differences between global temperature trends and temperature trends in the closest big city to where you live.

Steps to follow:

- Extract the data from the three databases provided
    - city_list
    - city_data
    - global_data

- Plot a line chart using moving averages to compare your city's temperature with the global temperature
- Analyze the data to recommend your findings about the similarities and differences between the world averages and city's average and also explore overall trends

Database Schema:
The three tables have been provided by Udacity:

- city_list - (city, country). This contains a list of cities and countries in the database.
- city_data - (year, city, country, avg_temp). This contains the average temperatures for each city by year (ºC).
- global_data - (year, avg_temp). This contains the average global temperatures by year (ºC).

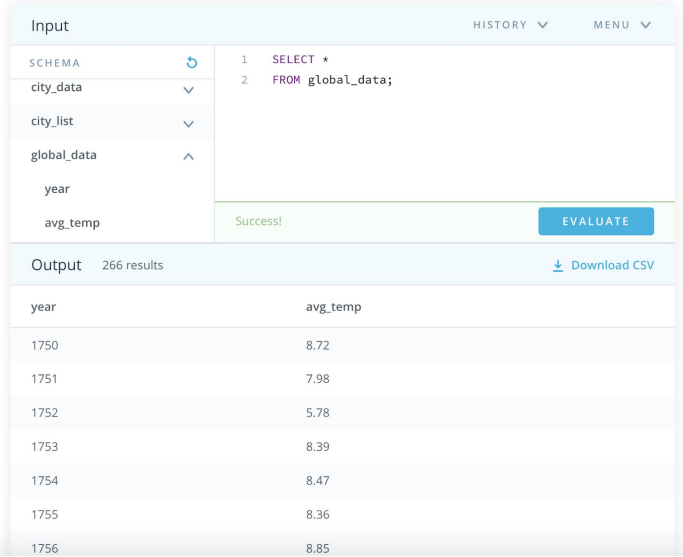
PROJECT IMPLEMENTATION

Stepwise Procedure:

1. Accessed the data by running SQL queries:

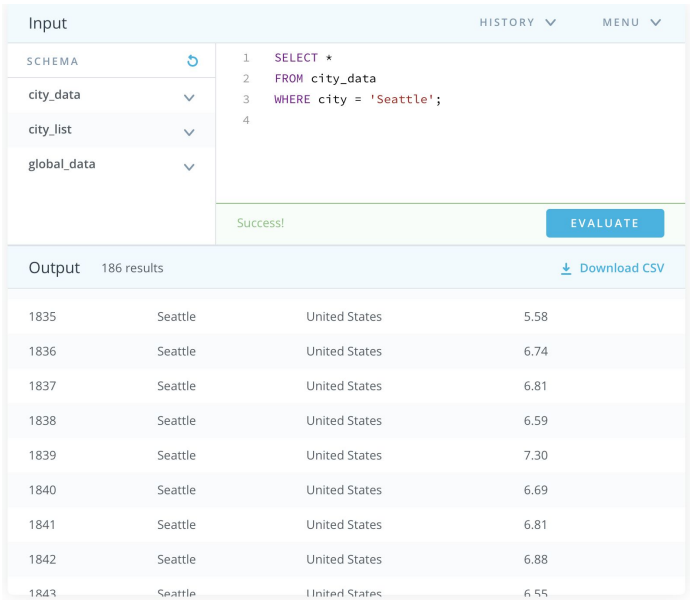
    1. For global average temperature:

        SELECT *
        FROM global_data;



    2. For the average temp of the city I reside in, Seattle:

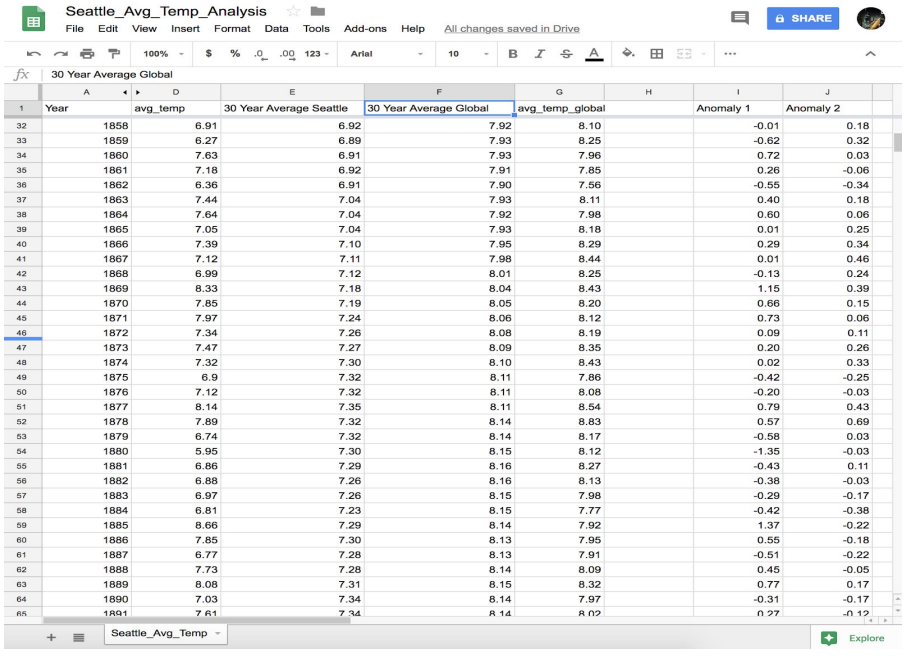
        SELECT *
        FROM city_data
        WHERE city = ‘Seattle’;



2. Downloaded the CSV files for each query.

3. Uploaded the data on Google Sheets and used the spreadsheets to analyze the data.

4. Calculated the **30 Year Moving Average** for each instance, ‘Global Average’ and ‘Seattle Average’. As per the article ‘How do scientists measure Global Temperature’, a 3-decade period is considered ‘normal’ or average to measure anomalies.



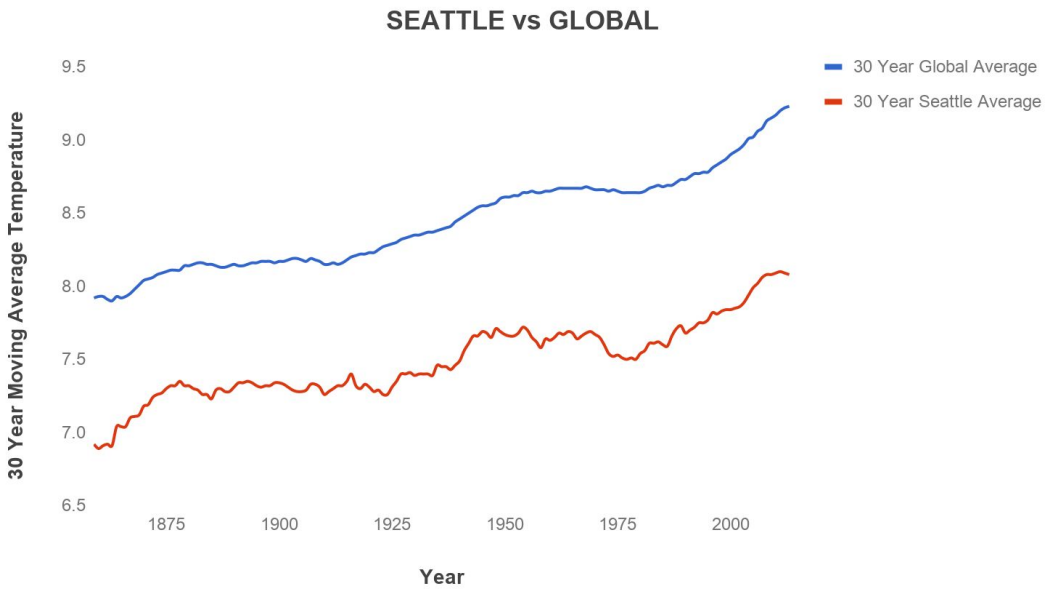
Year	avg_temp	30 Year Average Seattle	30 Year Average Global	avg_temp_global	Anomaly 1	Anomaly 2
1858	6.91	6.92	7.92	8.10	-0.01	0.18
1859	6.27	6.89	7.93	8.25	-0.62	0.32
1860	7.63	6.91	7.93	7.96	0.72	0.03
1861	7.18	6.92	7.91	7.85	0.26	-0.06
1862	6.36	6.91	7.90	7.56	-0.55	-0.34
1863	7.44	7.04	7.93	8.11	0.40	0.18
1864	7.64	7.04	7.92	7.98	0.60	0.06
1865	7.05	7.04	7.93	8.18	0.01	0.25
1866	7.39	7.10	7.95	8.29	0.29	0.34
1867	7.12	7.11	7.98	8.44	0.01	0.46
1868	6.99	7.12	8.01	8.25	-0.13	0.24
1869	8.33	7.18	8.04	8.43	1.15	0.39
1870	7.85	7.19	8.05	8.20	0.66	0.15
1871	7.97	7.24	8.06	8.12	0.73	0.06
1872	7.34	7.26	8.08	8.19	0.09	0.11
1873	7.47	7.27	8.09	8.35	0.20	0.26
1874	7.32	7.30	8.10	8.43	0.02	0.33
1875	6.9	7.32	8.11	7.86	-0.42	-0.25
1876	7.12	7.32	8.11	8.08	-0.20	-0.03
1877	8.14	7.35	8.11	8.54	0.79	0.43
1878	7.89	7.32	8.14	8.83	0.57	0.69
1879	6.74	7.32	8.14	8.17	-0.58	0.03
1880	5.95	7.30	8.15	8.12	-1.35	-0.03
1881	6.86	7.29	8.16	8.27	-0.43	0.11
1882	6.88	7.26	8.16	8.13	-0.38	-0.03
1883	6.97	7.26	8.15	7.98	-0.29	-0.17
1884	6.81	7.23	8.15	7.77	-0.42	-0.38
1885	8.66	7.29	8.14	7.92	1.37	-0.22
1886	7.85	7.30	8.13	7.95	0.55	-0.18
1887	6.77	7.28	8.13	7.91	-0.51	-0.22
1888	7.73	7.28	8.14	8.09	0.45	-0.05
1889	8.08	7.31	8.15	8.32	0.77	0.17
1890	7.03	7.34	8.14	7.97	-0.31	-0.17
1891	7.61	7.34	8.14	8.02	0.27	-0.12

Anomaly 1: (avg_temp) - (30 Year Average Seattle)
Anomaly 2: (avg_temp_global) - (30 Year Average Global)

Moving Average:

$(avg\_temp_{y1} + avg\_temp_{y2}\ldots+avg\_temp_{y30})/30$

5. Plotted the 30-year moving average to create a line chart for comparison between Seattle's temperatures and global temperatures.



6. Analyzed the data to understand the overall global and Seattle weather trends, and noted my observations which are mentioned in the next section. I am comparing the temperatures from 1858 to 2013, as that is the data we have for Seattle, with an emphasis on the last century.

OBSERVATIONS

- Evidently, there is an upward trend in the warming of the planet despite periods of cooling which are usually very small.

- The data suggests even though the average temperature in Seattle is lower than the global average, during the last 12 years (2001 - 2013), Seattle is getting warmer at a higher rate, 0.17 degrees celsius while the world at 0.02 degrees celsius.

- 2013 is the warmest year for Seattle with average temperature being 9.95 degrees celsius which is 1.78 more than the long term average of 8.17 degrees celsius and 1.87 more than the previous year. This has happened in the past in 1958, when the average temperature was 9.28 degree Celsius, 1.76 degree Celsius warmer than the previous year.

- Comparing the data from 1951 - 2000, we find that there's a positive trend in the global temperature with the rate of change as 0.01 where as the negative anomaly (-0.004) for Seattle suggests that the city had a few cooler seasons for years for the same period.

- Assessing the reference values with the average temperature we discover that Seattle almost once in a decade experiences an usually warm year, eg: 2013(1.78), 2004(1.05), 1992(1.28), 1987(0.96), 1967(0.70), 1958(1.64), 1941(1.22), 1940(1.25), 1934(1.58) and 1926(1.32).

- 1951 - 1960: This decade has seen 8 negative anomalies which means more cooler years for Seattle. Globally as well this was a cooler decade with 4 negative anomalies.

- Global anomaly or Anomaly 2 of the table suggests that the world has not experienced cooler years since 1986 and the average temperature for the year 1986 - 2013 is 9.31 and the rate of change is 0.02 degrees celsius.

- Both Seattle and Global average temperature suggest that the world is getting warmer, especially the last two decade, which has not seen any negative anomaly for global average temperature

REFERENCES

1. www. carbonbrief.org - ‘Explainer: How do scientists measure global temperature?’
2. www. wikipedia.org
3. National Center for Environmental Association