PROJECT Explore Weather Trends

July 7, 2020

STEPS TAKEN IN THE PROJECT

- **Data Extraction** *(Tools used: SQL)*
  - SQL queiries used in extracting data.
  - Extracting data for "Kathmandu" city only.
- **Data Cleaning** *(Tools used: Python, Pandas)*
  - Handling NUll(NAN/NA) values
- **Data Exploration** *(Tools used: Python, Pandas, Scipy)*
  - Calculating the moving averages with 10 years as a window.
- **Data Visualization** *(Tools used: Python, Matplotlib, Seaborn)*
  - Plotting the line-graphs between global avgerage and moving average temperature.
  - Plotting the graphs between Kathmandu average temperature and it's moving average.
  - Plotting the graphs between global moving average and kathmandu moving average.
  - Plotting the linear trend of the moving averages.
- **Observations**

0.1 Data Extraction

0.1.1 SQL Queries used in extracting data

[ ]:
```
#Extract all data from city_data table;
SELECT * FROM city_data;  #Data for kathmandu city is extracted later on using␣
 ↪pandas

#Extracct all data from city_list table;
SELECT * FROM city_list;

#Extract all data from global_data list;
SELECT * FROM globl_data;
```

[2]:
```
import numpy as np
import scipy as sp
import matplotlib.pyplot as plt
import pandas as pd
import scipy.stats as st
import seaborn as sns
import os
from sklearn.linear_model import LinearRegression
```

[3]:
```
filepath = '~/Documents/udacity/data-analyst/data-weather'
city_list = pd.read_csv(os.path.join(filepath, 'city_list.csv'), delimiter=',')
city_data = pd.read_csv(os.path.join(filepath,'city_data.csv'), delimiter=',')
global_data = pd.read_csv(os.path.join(filepath, 'global_data.csv'),␣
 ↪delimiter=',')
```

0.1.2 Extracting data for my city 'Kathmandu' only

[4]:
```
data_ktm = city_data[city_data["city"] == "Kathmandu"]
```

0.2 Data Cleaning

0.2.1 Handling Null values

[5]:
```
def check_null(data):
    for col in data.columns:
        isna_df = data[col].isna()
        print("Total null values in {} is {} ".format(col, sum(isna_df)))
```

[6]:
```
print("\n Checking Null values for 'global_data'")
check_null(global_data)

print("\n Checking Null Values for 'city_data'" )
check_null(city_data)

print("\n Checking Null Values for 'city_list'" )
check_null(city_list)
```

```
 Checking Null values for 'global_data'
Total null values in year is 0
Total null values in avg_temp is 0

 Checking Null Values for 'city_data'
Total null values in year is 0
Total null values in city is 0
```

```
Total null values in country is 0
Total null values in avg_temp is 2547

 Checking Null Values for 'city_list'
Total null values in city is 0
Total null values in country is 0
```

[7]:
```
isna_df = city_data["avg_temp"].isna()
```

[8]:
```
city_null_temp = city_data[isna_df]["city"].unique()
```

[9]:
```
'Kathmandu' in city_null_temp
```

[9]:
```
True
```

[10]:
```
data_ktm[data_ktm["avg_temp"].isna()]
```

[10]:

	year	city	country	avg_temp
30888	1808	Kathmandu	Nepal	NaN
30889	1809	Kathmandu	Nepal	NaN
30890	1810	Kathmandu	Nepal	NaN
30891	1811	Kathmandu	Nepal	NaN
30892	1812	Kathmandu	Nepal	NaN
30938	1858	Kathmandu	Nepal	NaN
30939	1859	Kathmandu	Nepal	NaN
30940	1860	Kathmandu	Nepal	NaN
30941	1861	Kathmandu	Nepal	NaN
30942	1862	Kathmandu	Nepal	NaN
30943	1863	Kathmandu	Nepal	NaN
30944	1864	Kathmandu	Nepal	NaN

[11]:
```
data_ktm.describe()
```

[11]:

	year	avg_temp
count	218.000000	206.000000
mean	1904.500000	14.663592
std	63.075352	0.539040
min	1796.000000	13.250000
25%	1850.250000	14.370000
50%	1904.500000	14.655000
75%	1958.750000	15.005000
max	2013.000000	16.560000

Replacing the NAN records of 'avg_temp' by the mean of avg_temp

[12]:
```
values = {"avg_temp" : np.mean(data_ktm["avg_temp"])}
df_ktm = data_ktm.fillna(value = values).copy()
```

[13]:
```
# checking whether the NAN value fwas illed in the 'avg_temp'column or not
df_ktm[(df_ktm["year"] >= 1808) & (df_ktm["year"] <= 1812)]
```

[13]:

	year	city	country	avg_temp
30888	1808	Kathmandu	Nepal	14.663592
30889	1809	Kathmandu	Nepal	14.663592
30890	1810	Kathmandu	Nepal	14.663592
30891	1811	Kathmandu	Nepal	14.663592
30892	1812	Kathmandu	Nepal	14.663592

0.3 Data Exploration

0.3.1 Calculating the Moving Averages with 10 years as a window

[14]:
```
df_ktm["moving_averages"] = df_ktm["avg_temp"].rolling(window = 10).mean()
```

[15]:
```
df_ktm.reset_index(inplace = True, drop = True)
```

[16]:
```
df_ktm_mov_avg = df_ktm.copy()
```

[17]:
```
df_ktm_mov_avg[10:20]
```

[17]:

	year	city	country	avg_temp	moving_averages
10	1806	Kathmandu	Nepal	14.700000	14.850000
11	1807	Kathmandu	Nepal	14.680000	14.730000
12	1808	Kathmandu	Nepal	14.663592	14.763359
13	1809	Kathmandu	Nepal	14.663592	14.753718
14	1810	Kathmandu	Nepal	14.663592	14.751078
15	1811	Kathmandu	Nepal	14.663592	14.791437
16	1812	Kathmandu	Nepal	14.663592	14.747796
17	1813	Kathmandu	Nepal	14.040000	14.666796
18	1814	Kathmandu	Nepal	13.520000	14.503796
19	1815	Kathmandu	Nepal	13.560000	14.381796

[18]:
```
df_kathmandu = df_ktm_mov_avg.copy()
df_global = global_data.copy()
```

[19]:
```
df_global["moving_averages"] = df_global["avg_temp"].rolling(window=10).mean()
```

[20]:
```
df_global.reset_index(inplace = True, drop = True)
```

0.3.2 Calculating the correlation coefficients

[21]:
```
#Take records in between 1796 to 2013 from global_data to match with the␣
 ↪available data of Kathmandu
split_global = df_global[(df_global["year"] >= 1796) & (df_global["year"] <=␣
 ↪2013)]
split_global.reset_index(inplace = True, drop = True)
```

[22]:
```
avg_global = split_global["avg_temp"]
avg_ktm  = df_kathmandu["avg_temp"]
```

[27]:
```
print("The Correlation Coeffiecient between global and kathmandu's average␣
 ↪temperature,and the P-Value are {} and {} .".format(st.pearsonr(avg_global,␣
 ↪avg_ktm)[0], st.pearsonr(avg_global, avg_ktm)[1]))
```

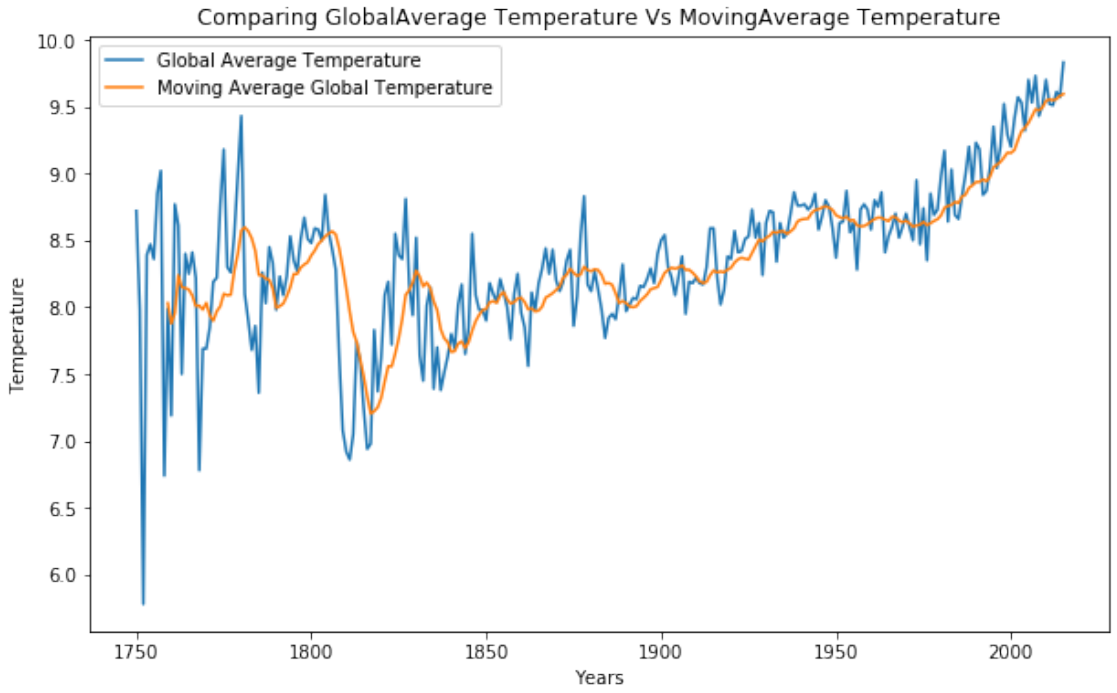
```
The Correlation Coeffiecient between global and kathmandu's average
temperature,and the P-Value are 0.7140927153194656 and 2.670490444560201e-35 .
```

0.4 Data Visualization

0.4.1 Plotting the line-graphs between global avgerage and moving average temperature.

[28]:
```
fig, ax = plt.subplots(figsize = (10,6))
sns.lineplot(x = "year", y = "avg_temp", data= df_global, label = "Global␣
 ↪Average Temperature")
sns.lineplot(x = "year", y = "moving_averages", data= df_global, label =␣
 ↪"Moving Average Global Temperature")
ax.legend()
ax.set_ylabel("Temperature")
ax.set_xlabel("Years")
ax.set_title("Comparing GlobalAverage Temperature Vs MovingAverage Temperature")
```

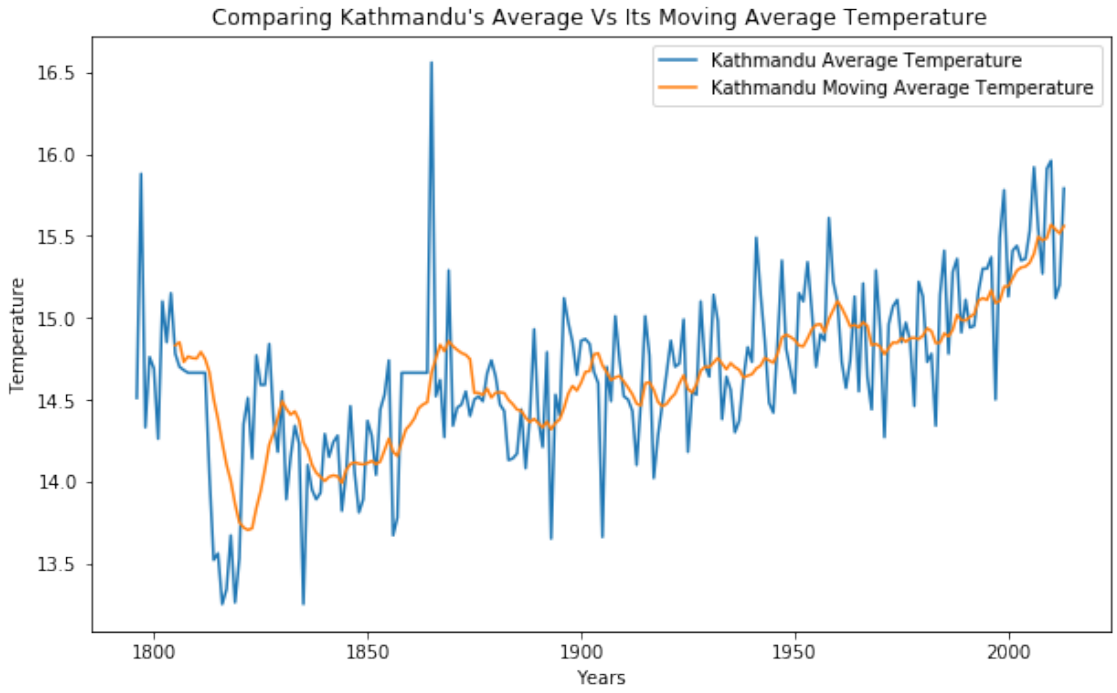
[28]:
```
Text(0.5, 1.0, 'Comparing GlobalAverage Temperature Vs MovingAverage
Temperature')
```



0.4.2 Plotting the line-graphs between Kathmandu average temperature and it's moving average

[29]:
```
# fig.savefig('global vs moving average', dpi= 100)
fig, ax = plt.subplots(figsize = (10, 6))
sns.lineplot(x = "year", y = "avg_temp", data= df_kathmandu, label= "Kathmandu␣
↪Average Temperature")
sns.lineplot(x = "year", y = "moving_averages", data = df_kathmandu, label =␣
↪"Kathmandu Moving Average Temperature")
ax.legend()
ax.set_ylabel("Temperature")
ax.set_xlabel("Years")
ax.set_title("Comparing Kathmandu's Average Vs Its Moving Average Temperature")
```

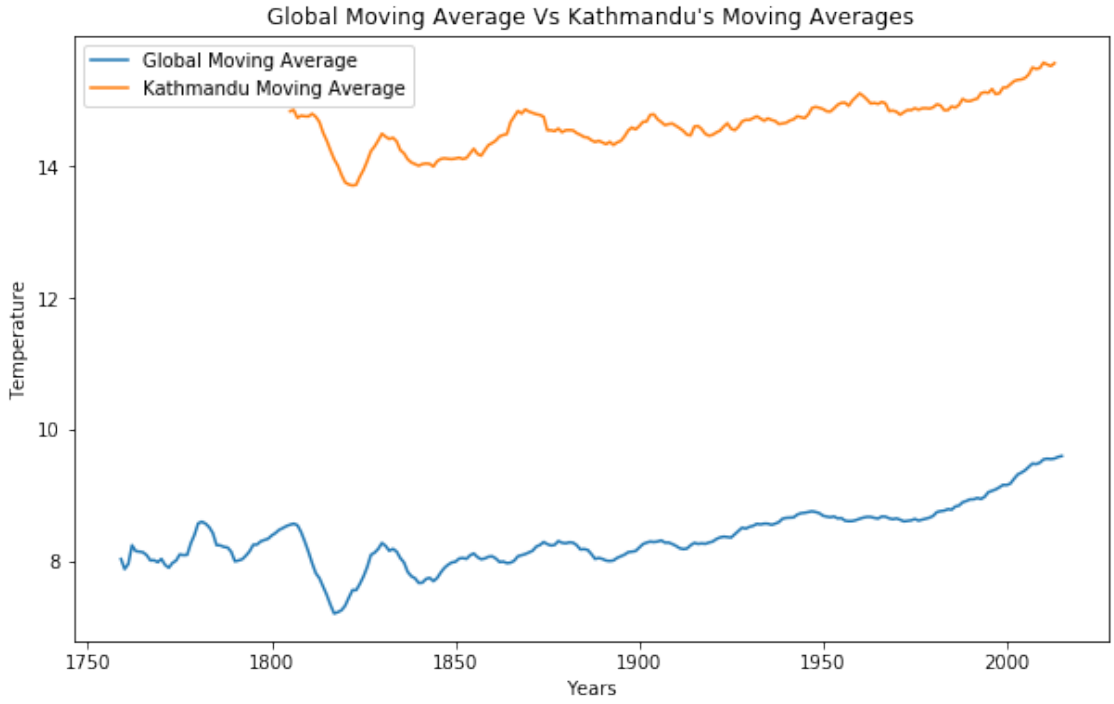
[29]:
```
Text(0.5, 1.0, "Comparing Kathmandu's Average Vs Its Moving Average
Temperature")
```



0.4.3 Plotting the line-graphs between global moving average and kathmandu moving average

[30]:
```
fig, ax = plt.subplots(figsize = (10,6))
sns.lineplot(x = "year", y = "moving_averages", data= df_global, label= "Global␣
↪Moving Average")
sns.lineplot(x = "year", y = "moving_averages", data = df_kathmandu, label =␣
↪"Kathmandu Moving Average")
ax.legend()
ax.set_ylabel("Temperature")
ax.set_xlabel("Years")
ax.set_title("Global Moving Average Vs Kathmandu's Moving Averages")
```

[30]:
```
Text(0.5, 1.0, "Global Moving Average Vs Kathmandu's Moving Averages")
```



0.4.4 Plotting the linear trends of the moving averages

[31]:
```
X_global = np.array(df_global["year"]).reshape(-1,1)
y_global = np.array(df_global["avg_temp"]).reshape(-1,1)
model_global = LinearRegression().fit(X= X_global, y= y_global)
trend_global = model_global.predict(X_global)
```

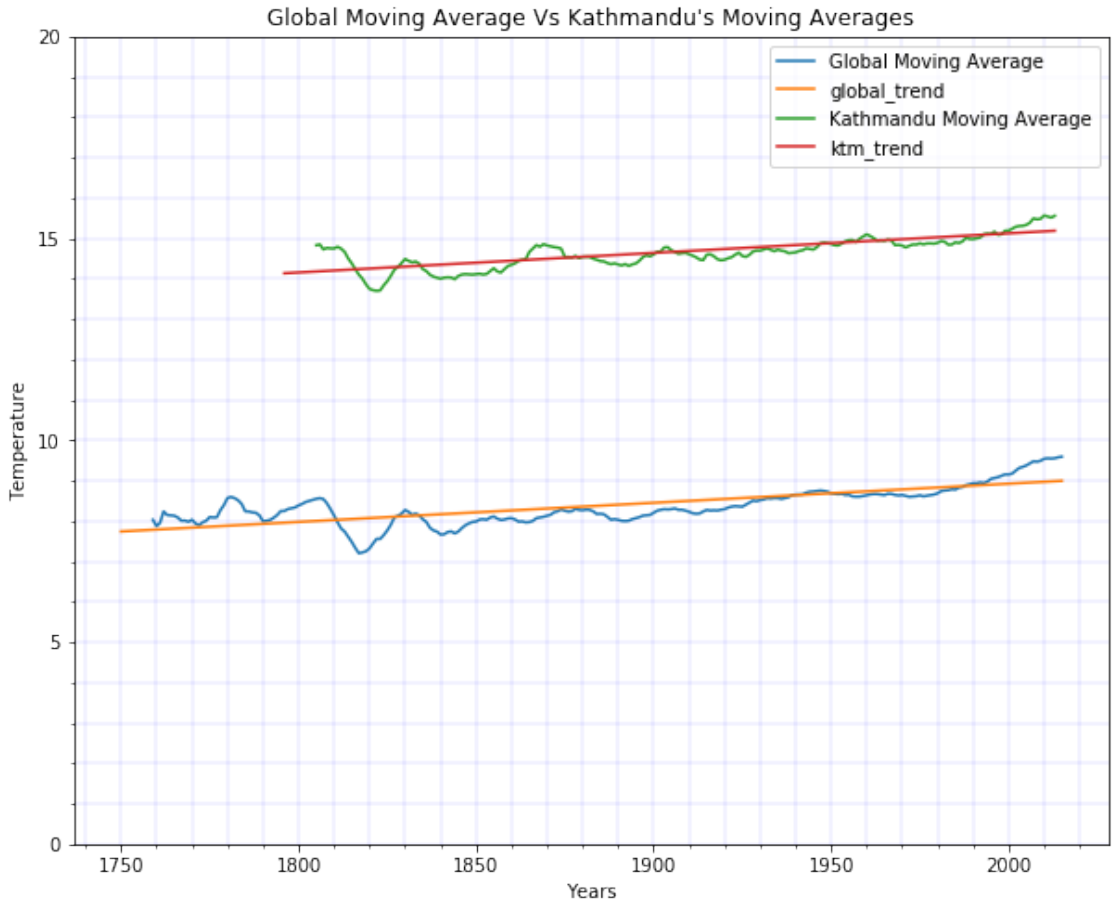
[32]:
```
X_ktm = np.array(df_kathmandu["year"]).reshape(-1,1)
y_ktm = np.array(df_kathmandu["avg_temp"]).reshape(-1,1)
model_ktm = LinearRegression().fit(X= X_ktm, y= y_ktm)
trend_ktm = model_ktm.predict(X_ktm)
```

[59]:
```
fig, ax = plt.subplots(figsize = (10,8))
sns.lineplot(x = "year", y = "moving_averages", data= df_global, label= "Global␣
↪Moving Average")
ax.plot( X_global, trend_global, label= "global_trend")

sns.lineplot(x = "year", y = "moving_averages", data = df_kathmandu, label =␣
↪"Kathmandu Moving Average")
ax.plot(X_ktm, trend_ktm, label = "ktm_trend")
ax.set_xticks(np.arange(1750, 2030, 50))
ax.set_yticks(np.arange(0, 25, 5))
ax.minorticks_on()
```

```
ax.grid(which = 'both',color = 'b', linestyle='-', linewidth= 0.1, )
ax.legend()
ax.set_ylabel("Temperature")
ax.set_xlabel("Years")
ax.set_title("Global Moving Average Vs Kathmandu's Moving Averages")
```

[59]: Text(0.5, 1.0, "Global Moving Average Vs Kathmandu's Moving Averages")



0.5 Observations

- There is an upward trend for both the global average and kathmandu's average temperature.
- Kathmandu's average temperaure looks clearly hotter than the global average temperature in last 200 years.
- Both has the lowest recorded temperature in between 1815-1825 and highest recorded temperature in 2013-2015.That means the effect of the global warming is being felt on earth.
- In a period of 200 years, there is a little more than 1 degree celsius increment in temperature of earth and Kathmandu city.

- With a correlation of 0.71, Kathmandu city shows similar pattern of moving averages with global moving averages clearly indicating that it has felt the effect of global temperature. This may be caused by the presence of Himalayan range in Nepal, consisting 8 out of top 10 highest peaks in the world, which has melted due to global warming in last 200 years.
- kathmandu's temperature had almost stagnant temperature in between 1950 and 1990, while the global temperature was increasing in the same period.