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Project 1: Exploring Weather Trends

Outline

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- Data
- Analysis
- Results

Purpose

Describing the similarities and differences between global temperature trends, and temperature trends in the closest big city to where I live, San Jose and my hometowns, Los Angeles and Taipei.

Tools and Methods

I wrote SQL queries for extracting the city and global data from database, and saved them as csv files. The report was generated by RMarkdown. I used the libraries readr, dplyr, ggplot and caret to manipulate the data, and create line charts

Data

I extracted the data from the database, and picked my current location, San Jose, and my hometowns, Los Angeles and Taipei.

- city list includes the variables, city and country
  SELECT *
  FROM city_list
  ORDER BY country, city

- city data includes the variables, city, country, year, avg_temp
  SELECT *
  FROM city_data
  WHERE city IN ('San Jose', 'Los Angeles','San Francisco') AND country = 'United States'

- city data

```
SELECT *
FROM city_data
WHERE city = 'Taipei'
```

- global data includes the variables, year and avg_temp

```
SELECT *
FROM global_data
```

Analysis

1) I imported the csv files into R.

   Note: I only kept the period of time from 1849 to 2013 for each dataset because it is easy and fair for comparison.

2) I created a function for calculating moving averages by using global dataset. I calculated 3 year, 5 year, 7 year and 10 year moving averages and generated a line chart for all of them. In the line charts, the lines of 3 year and 5 year look relatively rough compared to 7 year and 10 year. However, the line of 10 year is too smooth and takes out some of detail. Thus, I found that the line of 7 year moving average is smooth and does not lack too much of information of the data.

   Note: During the calculation of moving average, 1st to 6th year in the dataset were missing because 7 year moving average is calculated from 7th year. To avoid showing the line of NA group in line charts, I removed them from the datasets.

3) I generated the following line charts.

- 7 year moving average in Global
- 7 year moving average in San Jose
- 7 year moving average in Global versus San Jose
- 7 year moving average in Los Angeles
- 7 year moving average in Taipei
- 7 year moving average in the world, San Jose, Los Angeles and Taipei

Results

1) Compared the 7 year moving average temperature in my current city, San Jose with in the world from 1849 to 2013

- The temperature trends in the world and San Jose has gradually become hotter and hotter, especially from 1975 to 2013.
- The temperature in San Jose has not been consistent going up. Before 1975, the temperature has been dramatically up and down. The temperature in the world has been consistent going up, especially from 1975 to 2013.
- The average temperature in San Jose is hotter than in the world, around 6 degrees difference.
- In the world, the year is highly and positively correlated with average temperature than in San Jose.

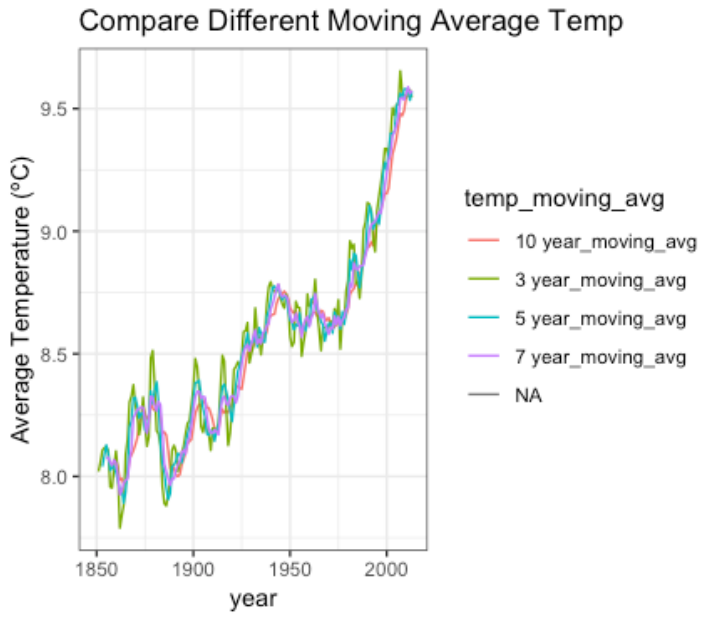
- Using linear regression for estimating the average temperature in San Jose based on the global temperature is not accurate. The estimated temperatures are very off from the actual temperatures, might choose different models in the future.

2) Compared the 7 year moving average temperature among the world, San Jose, Los Angeles and Taipei from 1849 to 2013.

- The temperature in Taipei has been the hottest over the time compared to the world, San Jose and Los Angeles.
- The temperatures in San Jose and in Los Angeles have the similar trends over the years even though the temperature in Los Angeles has been always higher than in San Jose over the years.
- The temperatures in San Jose, Los Angeles, and Taipei are all higher than in the world.
- The world has highest correlation between year and average temperature compared to San Jose, Los Angeles and Taipei.

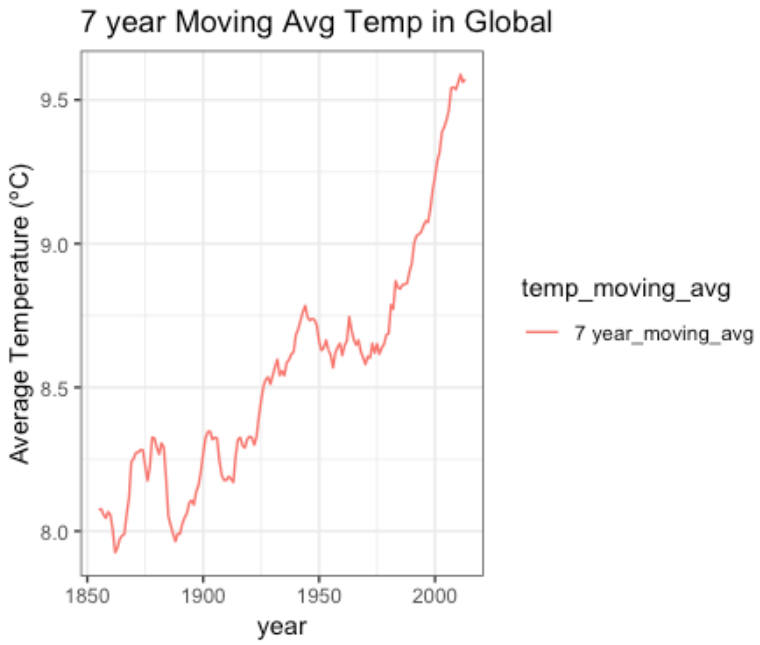
```
## 1) Reading datasets
library(readr)
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

# a. Global
global <- read_csv("global.csv")

## Parsed with column specification:
## cols(
##   year = col_integer(),
##   avg_temp = col_double()
## )

# Make the time period the same like San Jose and Los Angeles
global2 <- global %>%
  filter(year >= 1849 & year <= 2013)

# b. My current Location: San Jose
cities <- read_csv("cities.csv")

## Parsed with column specification:
## cols(
##   year = col_integer(),
##   city = col_character(),
##   country = col_character(),
##   avg_temp = col_double()
## )
```

```
sj <- cities %>%
  filter(city == 'San Jose') %>%
  select(year,avg_temp)

# c. The city I stayed before the Bay: Los Angeles
la <- cities %>%
  filter(city == 'Los Angeles') %>%
  select(year,avg_temp)

# d. My hometown: Taipei
tpi <- read_csv("tpi.csv") %>%
  filter(year >= 1849 & year <= 2013) %>%
  select(year,avg_temp)

## Parsed with column specification:
## cols(
##   year = col_integer(),
##   city = col_character(),
##   country = col_character(),
##   avg_temp = col_double()
## )

## 2) Create a function for calculating moving average
move <- function(data,loc,y){
    mov_year = data.frame()
    locat = data.frame()
    year = data.frame()
    movavg = data.frame()
    for(i in 1:length(data$avg_temp)){
        if (i < y){
            x <- NA
            z <- NA
        }
            else{
                x <- data %>%
                summarize(movmean = mean(avg_temp[(i-(y-1)):i]))
                z <- paste(y,'year_moving_avg')
                }
        movavg = rbind(movavg,data.frame(as.numeric(x)))
        year = rbind(year,z)
        locat = rbind(locat,loc)
    }
    names(locat) <- 'location'
    names(movavg) <- 'mov_avg'
    names(year) = 'temp_moving_avg'
    mov_year <- cbind(data,movavg,year,locat)
    return(mov_year)
}

globalall <-
rbind(move(global2,'Global',3),move(global2,'Global',5),move(global2,'Global',7),move(global2,
'Global',10))

library(ggplot2)
ggplot(data=globalall, aes(x=year, y=mov_avg, color=temp_moving_avg))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("Compare Different Moving Average Temp")

## Warning: Removed 21 rows containing missing values (geom_path).
```

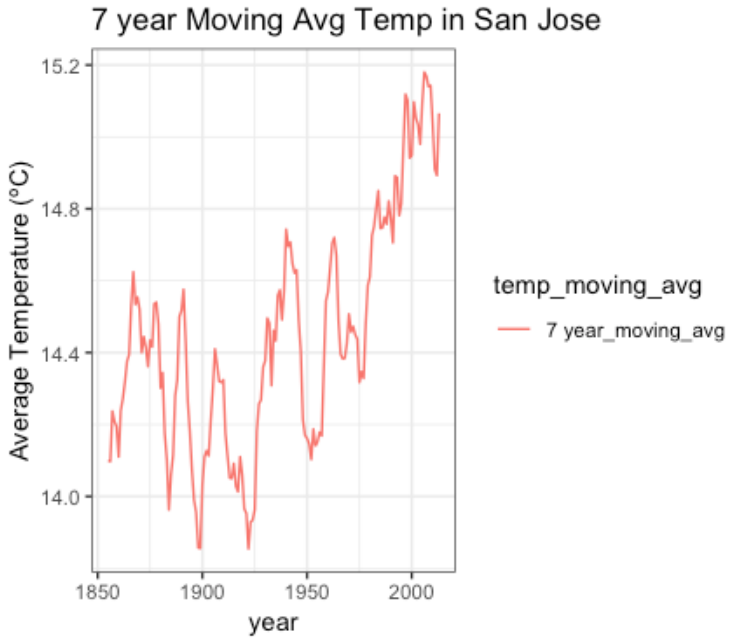



```
# Remove the NAs
global7 <- move(global2,'Global',7) %>%
    filter(year >= 1855)
head(global7)

##   year avg_temp  mov_avg   temp_moving_avg location
## 1 1855     8.11 8.074286 7 year_moving_avg   Global
## 2 1856     8.00 8.077143 7 year_moving_avg   Global
## 3 1857     7.76 8.057143 7 year_moving_avg   Global
## 4 1858     8.10 8.045714 7 year_moving_avg   Global
## 5 1859     8.25 8.067143 7 year_moving_avg   Global
## 6 1860     7.96 8.055714 7 year_moving_avg   Global

sj7 <- move(sj,'San Jose',7) %>%
  filter(year >= 1855)
head(sj7)

##   year avg_temp  mov_avg   temp_moving_avg location
## 1 1855    14.20 14.10000 7 year_moving_avg San Jose
## 2 1856    14.10 14.09714 7 year_moving_avg San Jose
## 3 1857    14.78 14.23714 7 year_moving_avg San Jose
## 4 1858    14.19 14.20857 7 year_moving_avg San Jose
## 5 1859    13.71 14.19429 7 year_moving_avg San Jose
## 6 1860    13.81 14.11000 7 year_moving_avg San Jose

glo_sj <- rbind(global7,sj7)

la7 <- move(la,'Los Angeles',7) %>%
  filter(year >= 1855)
head(la7)

##   year avg_temp  mov_avg   temp_moving_avg    location
## 1 1855    15.94 15.72571 7 year_moving_avg Los Angeles
## 2 1856    15.52 15.69857 7 year_moving_avg Los Angeles
## 3 1857    16.19 15.82857 7 year_moving_avg Los Angeles
## 4 1858    15.67 15.84857 7 year_moving_avg Los Angeles
## 5 1859    15.29 15.80286 7 year_moving_avg Los Angeles
## 6 1860    15.41 15.68000 7 year_moving_avg Los Angeles
```

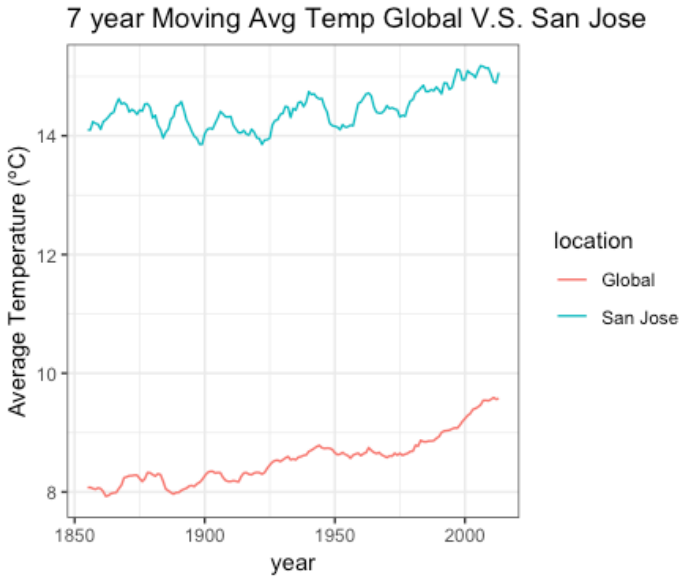
```
tpi7 <- move(tpi,'Taipei',7) %>%
  filter(year >= 1855)
head(tpi7)

##   year avg_temp  mov_avg   temp_moving_avg location
## 1 1855    21.89 21.94714 7 year_moving_avg   Taipei
## 2 1856    21.54 21.92714 7 year_moving_avg   Taipei
## 3 1857    21.94 21.93571 7 year_moving_avg   Taipei
## 4 1858    21.67 21.91000 7 year_moving_avg   Taipei
## 5 1859    21.87 21.90714 7 year_moving_avg   Taipei
## 6 1860    21.70 21.83286 7 year_moving_avg   Taipei

glob_city <- rbind(global7,sj7,la7,tpi7)

## 3) Data Visualization
library(ggplot2)

ggplot(data=global7, aes(x=year, y=mov_avg, color=temp_moving_avg))+geom_line()+
    ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Temp in Global")
```



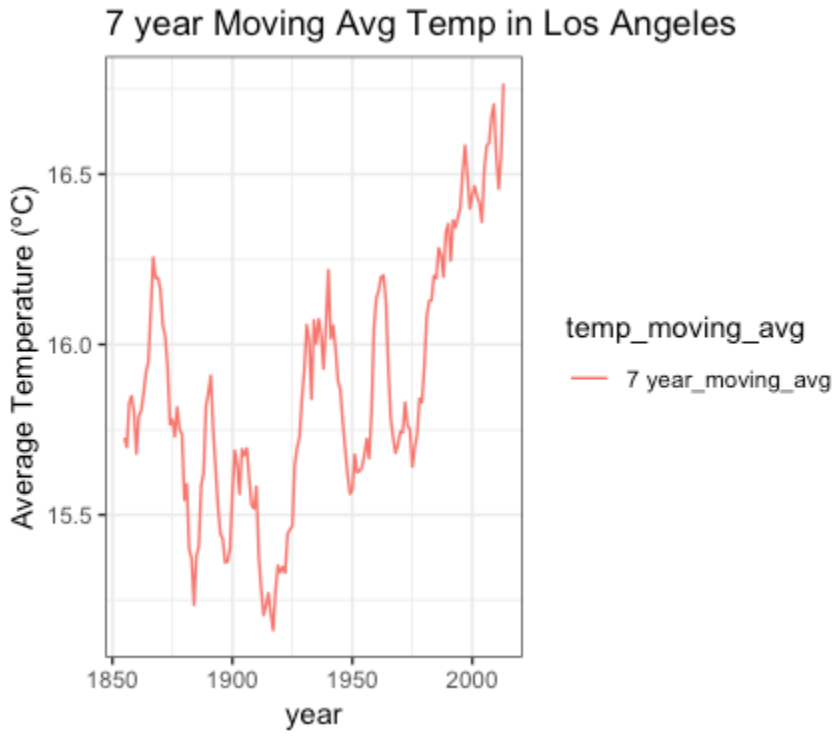

```
ggplot(data=sj7, aes(x=year, y=mov_avg, color=temp_moving_avg))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Temp in San Jose")
```



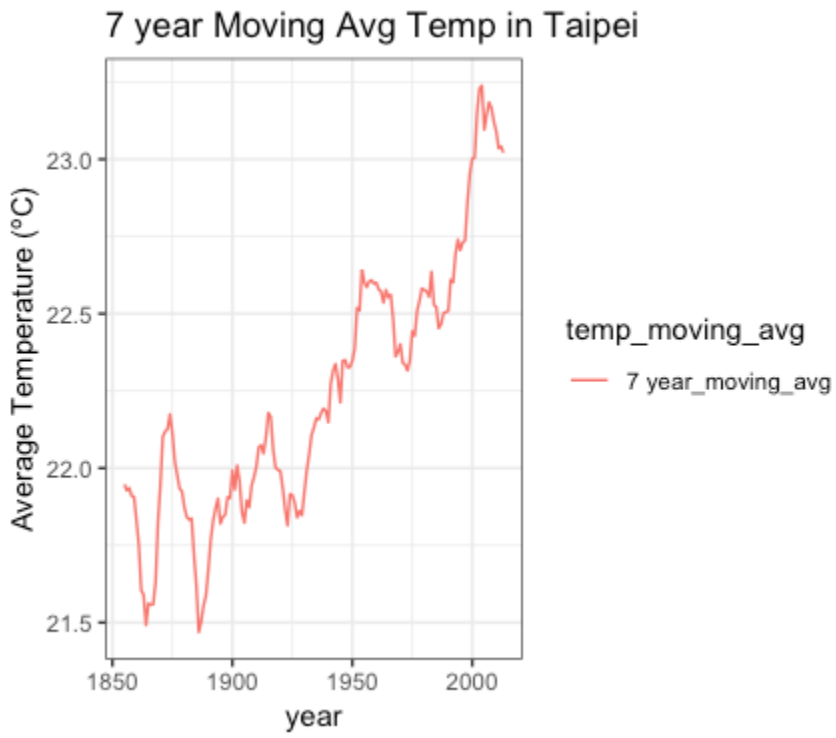

```
ggplot(data=glo_sj, aes(x=year, y=mov_avg, color=location))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Tem Global V.S. San
Jose")
```



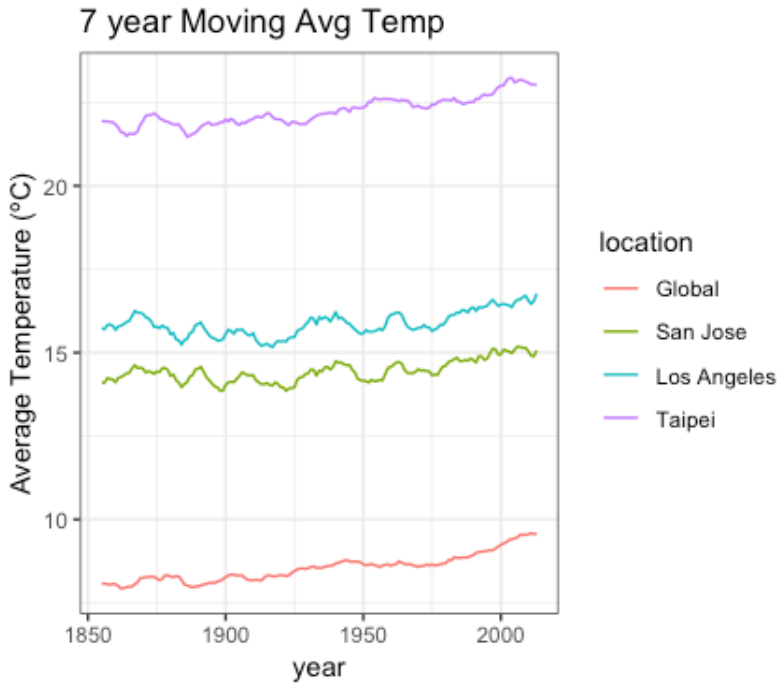

```
ggplot(data=la7, aes(x=year, y=mov_avg, color=temp_moving_avg))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Temp in Los Angeles")
```




```
ggplot(data=tpi7, aes(x=year, y=mov_avg, color=temp_moving_avg))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Temp in Taipei")
```




```
ggplot(data=glob_city, aes(x=year, y=mov_avg, color=location))+geom_line()+
  ylab("Average Temperature (ºC)")+theme_bw()+ggtitle("7 year Moving Avg Temp")
```


7 year Moving Avg Temp
Average Temperature (°C)
20
15
10
1850
1900
1950
2000
year
location
Global
San Jose
Los Angeles
Taipei