# Mini project for BCEE 231

- **Deadline: Monday, December 5th, 2022 @ 5:00 PM**
- **The submission should be made to tutors in the form of ONE hardcopy. Tutors will not mark any submission that is not submitted as hardcopy.**
- **The submission should include both computer programs (along with any related functions) and the outputs of the programs.**
- **This project include 10% bonus mark dedicated to those students, who come up with accurate and concise flowcharts for the whole project.**

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**Project topic: statistical analyses of temperature data in Canada**

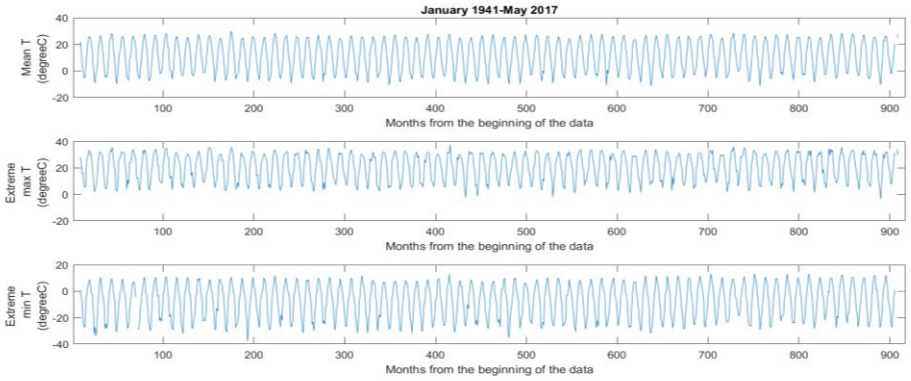
**Please note that a step-by-step guideline provided immediately after the questions.**

1- On the first page of your submission write in BOLD your student ID and the latitude and longitude of the grid assigned to you. Where about in Canada or Alaska your grid is located? Write it down in BOLD.
2- Download the data matrix and select the row which includes the data of your grid. Columns 4 onward includes the daily mean temperature (in degree Celsius data) from 1975-01-01 to 2016-12-31.
3- Using the daily temperature data, extract mean monthly temperature, extreme minimum monthly temperature (the daily temperature in the coldest day of the month), and extreme maximum monthly temperature (the daily temperature of the hottest day of the month). What is the coldest and hottest temperature values in the whole data period and the days they occurred (10%)?
4- Plot the timeseries for the three variables you extracted in part 3. Give appropriate title and label to each figure (10%).
5- Divide each of the timeseries into 12 separate series related to each Julian month (all Januaries together, all Februaries together and so on). Create a table that includes the statistical information (min, mean, median, mode, max, std) of the data in each Julian month (40%).
6- Fit a line to each monthly timeseries. Plot the data along with the fitted line. Based on the slope of the line, decide whether the data in each month show an increasing or decreasing trend, or have no change in time. Based on your analyses, discuss how the climate is changing in the location you are studying (40%).
7- Summarize the code and calculation procedure you designed through an effective, accurate and concise flowchart (10% bonous).

**Guidelines**

This project resembles standard climate data analyses that will be used for variety of civil, building and environmental engineering applications. The procedure from step 4 onward is replicated below for the city of Montreal.

- To plot monthly timeseries of minimum, mean and maximum monthly temperature values, use the similar application of the subplot function as shown below for Montreal.

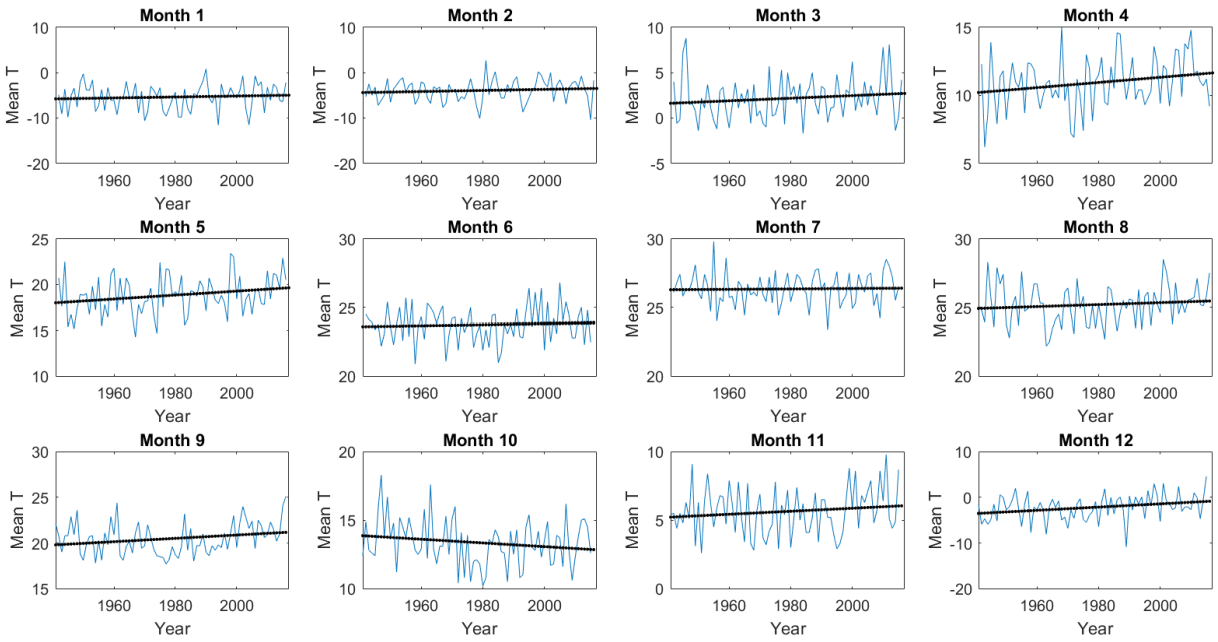



- Ideally your table should look like this. The following table is related to Montreal.

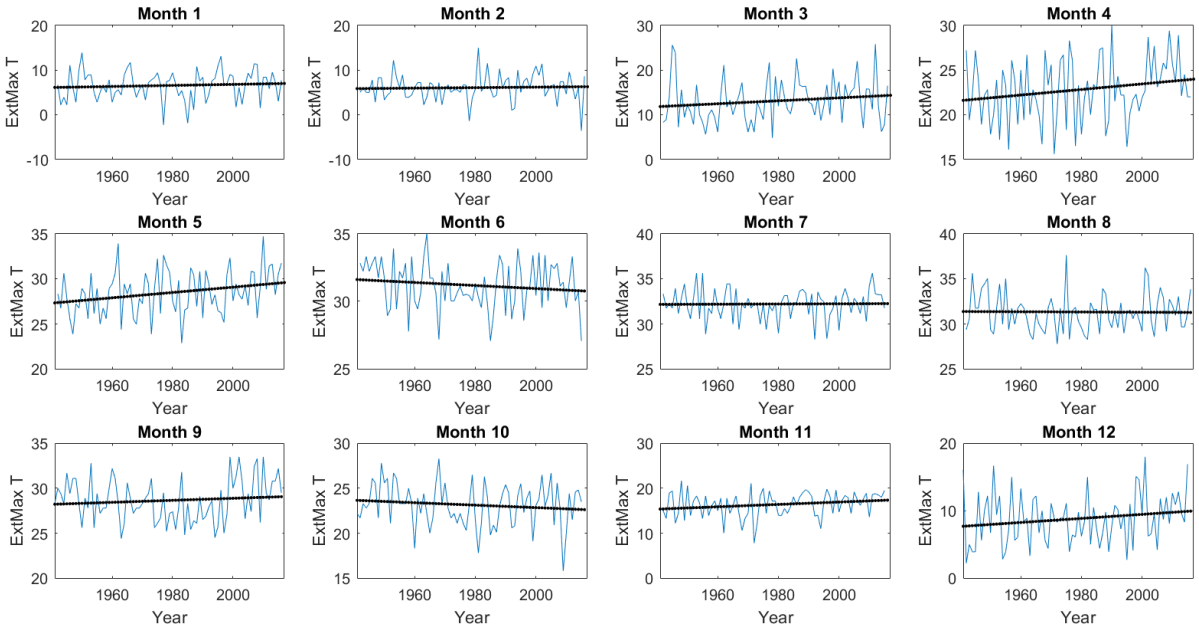
| Variable | Month | min | mean | median | mode | max | std |
|---|---|---|---|---|---|---|---|
| Mean T | Jan | -11.60 | -5.38 | -5.20 | -6.10 | 0.80 | 2.83 |
| | Feb | -10.40 | -3.93 | -3.60 | -3.20 | 2.70 | 2.44 |
| | Mar | -1.70 | 2.17 | 1.70 | 0.80 | 8.80 | 2.33 |
| | Apr | 6.20 | 10.93 | 11.00 | 10.40 | 15.00 | 1.89 |
| | May | 14.30 | 18.81 | 18.80 | 16.70 | 23.40 | 2.10 |
| | Jun | 20.90 | 23.75 | 23.80 | 23.80 | 26.80 | 1.31 |
| | Jul | 23.40 | 26.33 | 26.35 | 26.10 | 29.80 | 1.18 |
| | Aug | 22.20 | 25.18 | 25.20 | 23.50 | 28.50 | 1.44 |
| | Sep | 17.70 | 20.48 | 20.25 | 19.70 | 25.10 | 1.75 |
| | Oct | 10.20 | 13.36 | 13.10 | 10.80 | 18.30 | 1.73 |
| | Nov | 2.60 | 5.64 | 5.50 | 5.20 | 9.80 | 1.73 |
| | Dec | -10.90 | -2.18 | -2.10 | -2.80 | 4.60 | 2.82 |
| ExtMax T | Jan | -2.30 | 6.55 | 6.70 | 6.70 | 13.90 | 3.21 |
| | Feb | -3.60 | 6.06 | 6.10 | 5.00 | 15.00 | 2.96 |
| | Mar | 4.80 | 13.08 | 12.40 | 10.00 | 25.80 | 4.84 |
| | Apr | 15.60 | 22.79 | 22.80 | 20.00 | 30.00 | 3.50 |
| | May | 22.90 | 28.42 | 28.30 | 29.40 | 34.70 | 2.47 |
| | Jun | 27.10 | 31.16 | 31.20 | 30.00 | 35.00 | 1.77 |
| | Jul | 28.30 | 32.16 | 32.25 | 31.70 | 35.60 | 1.62 |
| | Aug | 27.80 | 31.28 | 31.20 | 31.70 | 37.60 | 2.10 |
| | Sep | 24.40 | 28.64 | 28.30 | 27.80 | 33.50 | 2.38 |
| | Oct | 15.80 | 23.14 | 23.30 | 23.30 | 28.30 | 2.40 |
| | Nov | 7.80 | 16.37 | 17.10 | 14.40 | 21.70 | 2.79 |
| | Dec | 2.20 | 8.81 | 8.90 | 3.90 | 18.00 | 3.77 |
| ExtMin T | Jan | -37.80 | -26.38 | -26.70 | -28.30 | -16.80 | 3.44 |
| | Feb | -33.90 | -24.85 | -25.00 | -26.10 | -15.70 | 4.10 |
| | Mar | -29.40 | -18.10 | -17.80 | -20.60 | -7.80 | 4.69 |
| | Apr | -15.00 | -6.67 | -6.30 | -8.30 | 0.10 | 3.07 |
| | May | -4.40 | 0.49 | 0.60 | 2.20 | 4.70 | 1.98 |
| | Jun | 0.00 | 5.81 | 5.85 | 5.00 | 9.80 | 2.23 |
| | Jul | 6.10 | 9.84 | 10.00 | 10.00 | 13.30 | 1.62 |
| | Aug | 3.30 | 7.74 | 7.75 | 7.20 | 12.00 | 1.85 |
| | Sep | -2.20 | 2.05 | 1.70 | 3.90 | 9.70 | 2.42 |
| | Oct | -7.20 | -3.55 | -3.70 | -5.60 | 1.50 | 1.78 |
| | Nov | -19.40 | -10.77 | -10.30 | -8.90 | -3.30 | 3.25 |
| | Dec | -32.40 | -22.38 | -22.10 | -28.30 | -12.10 | 4.26 |

- Following descriptions briefly outlines how part 5 should be handled.
  1) To fit a linear fit to the data using polyfit function in MATLAB
  2) You need to plot the data and fitted lines related to each variable in a separate figures and plot different months as subplots. The following figures show how the plots should look like for variables in Montreal.

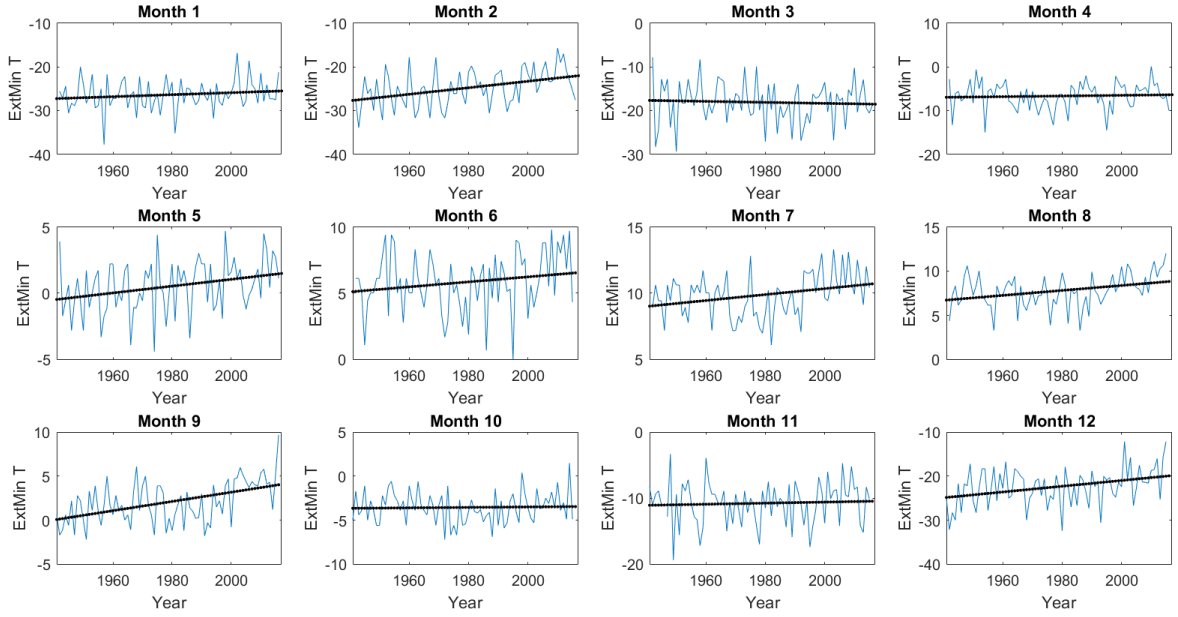
Mean T:




ExtMax T:



ExtMin T:




3) The following table shows the slope of the fitted line for each variable and in each month. The fitted lines are obtained by polyfit and shown in above figures. To analyze the climate change in your city you can create a similar table for your variables of interest. If the slope is below 0, it means decreasing with time. If it is above 0 means that it is increasing with time. If it is 0, it means that the variable is not changing with time. Do not underestimate discussing your results.

| Month | Mean T | ExtMax T | ExtMin T |
|---|---|---|---|
| **Jan** | 0.01 | 0.01 | 0.02 |
| **Feb** | 0.01 | 0.01 | 0.07 |
| **Mar** | 0.01 | 0.03 | -0.01 |
| **Apr** | 0.02 | 0.03 | 0.01 |
| **May** | 0.02 | 0.03 | 0.03 |
| **Jun** | 0.00 | -0.01 | 0.02 |
| **Jul** | 0.00 | 0.00 | 0.02 |
| **Aug** | 0.01 | 0.00 | 0.03 |
| **Sep** | 0.02 | 0.01 | 0.05 |
| **Oct** | -0.01 | -0.01 | 0.00 |
| **Nov** | 0.01 | 0.03 | 0.01 |
| **Dec** | 0.04 | 0.03 | 0.07 |

- Flowcharts need to be complete, comprehensive and detailed; yet they must be concise and can be shown in ONE single page at most.