

Mini project for BCEE 231

- **Deadline: Monday, December 7th, 2019 @ 5:00 PM**
 - **The submission should be made to tutors in PDF form.**
 - **The submission should include both computer programs (along with any related functions) and the outputs of the programs.**
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Project topic: statistical analyses of temperature data in Canada

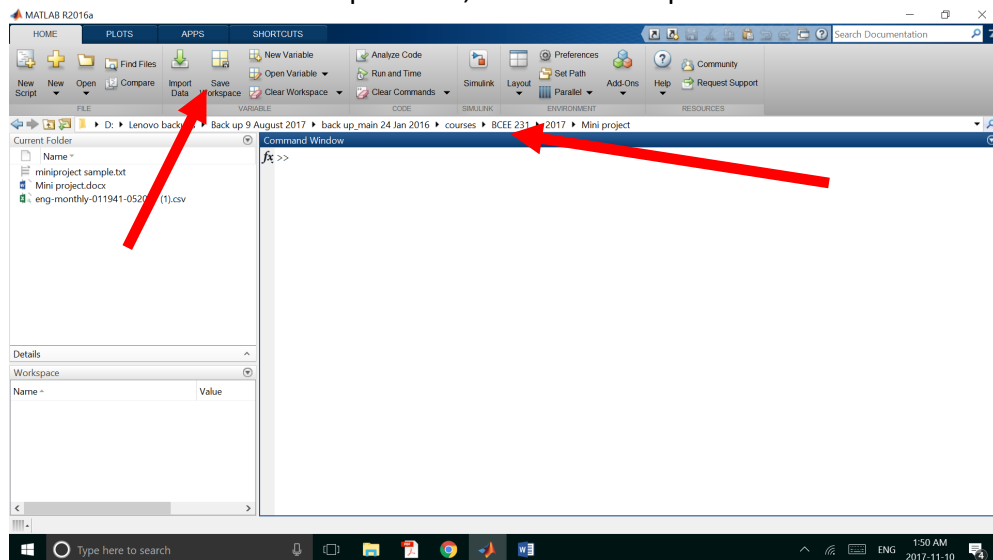
Please note that a step-by-step guideline provided immediately after the questions.

- 1- On the first page of your submission write in BOLD the name of the station assigned to you.
- 2- Download the daily maximum, mean and minimum temperature related to your station for the period of 1977 to 2016¹ from Canadian Climate Data Accessibility Portal (CCDAP), available at <https://www.concordia.ca/ginacody/building-civil-environmental-eng/research/water-security-climate-change-lab/data-applications/ccdap.html>.
- 3- Using the daily temperature data, extract mean monthly temperature, extreme minimum monthly temperature (the coldest temperature of the month), and extreme maximum monthly temperature (the hottest temperature of the month). What is the coldest and hottest temperature of (10%).
- 4- Plot the timeseries for the three variables asked from you. 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 your city (40%).
- 7- Summarize the code and calculation procedure you designed through an effective, accurate and concise flowchart (10% bonus).

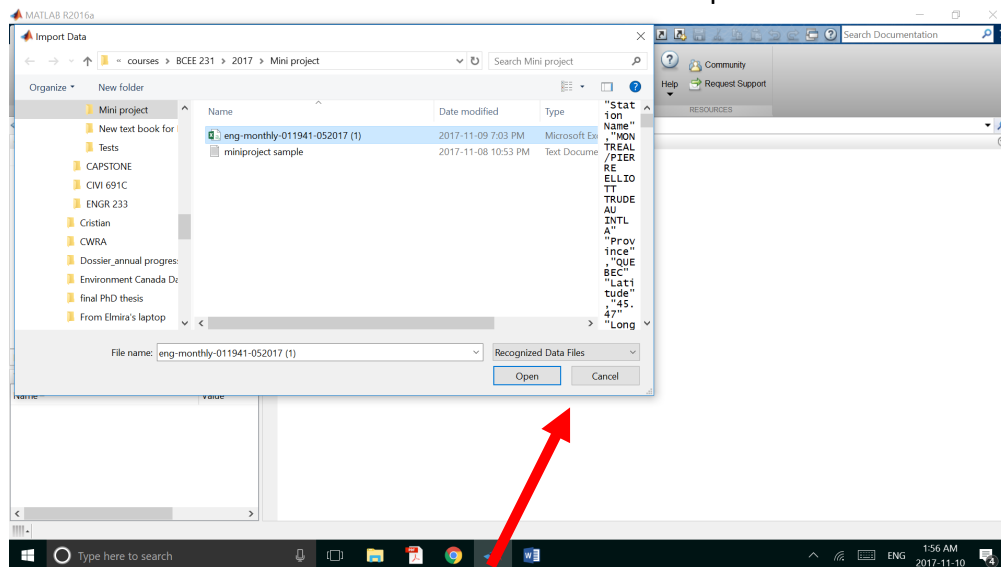
¹ If your station does not include the desired period of 1977 to 2016, consider any other 40 years in which your station has data. If your station includes a large period with missing data, which makes the total continuous data less than less 20 years in total, please contact your instructor for a substitute station.

Guidelines

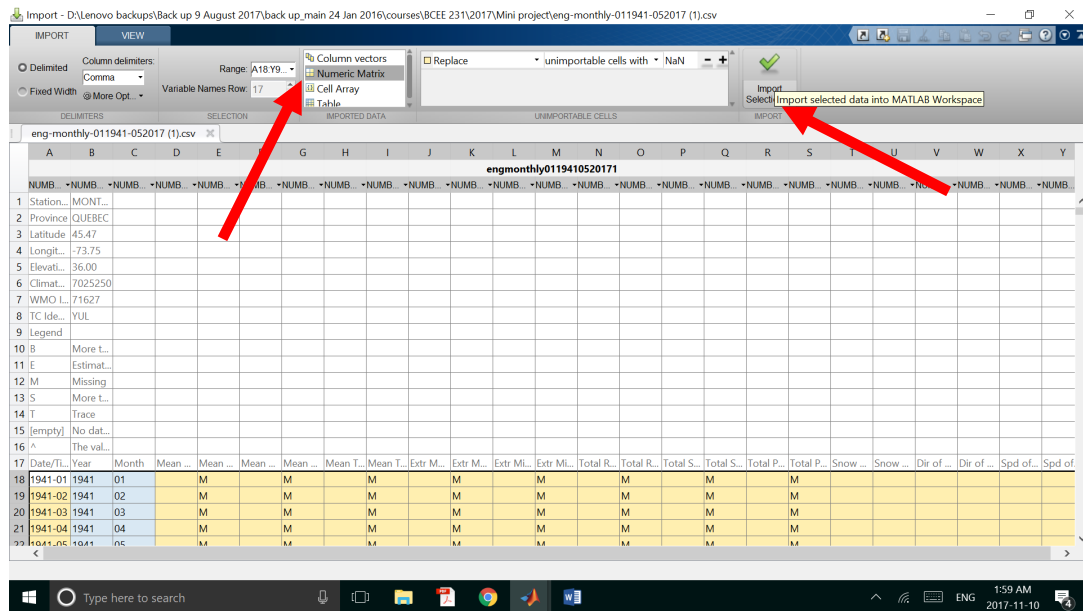
- The name of the station, for which you need to do the analyses is given to you. The three variables you are interested would be mean daily temperature, maximum daily temperature, and minimum daily temperature.
- To access to the climate data go to <https://www.concordia.ca/ginacody/building-civil-environmental-eng/research/water-security-climate-change-lab/data-applications/ccdap.html> and search for the name of your city. Follow the flow procedure in the webpage to select daily data and download all the data in one Excel file.
- To prepare the data for further analyses:
 1. Open the Excel file in MATLAB through import tool or through xlsread. If you want to use the import tool, click on the Import Data on MATLAB toolbar.



2. Select the downloaded Excel file and click on open



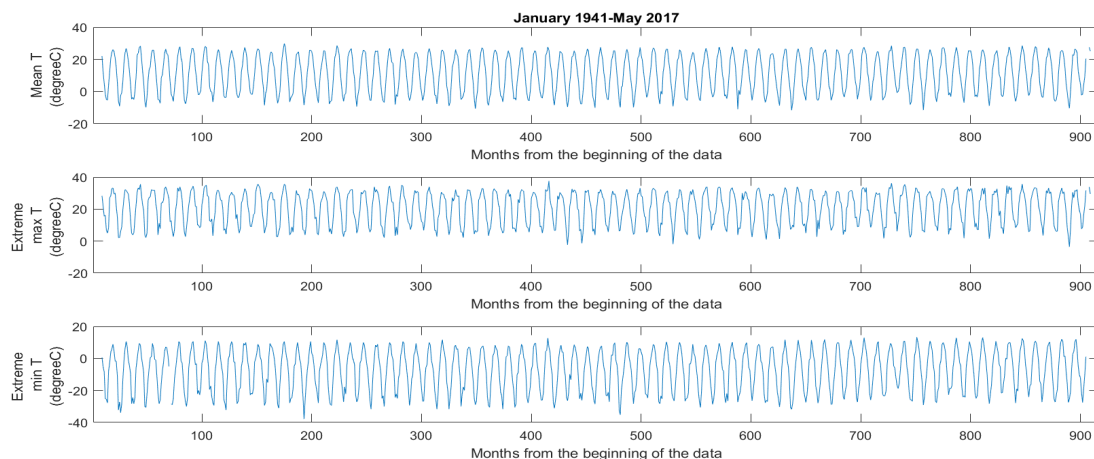
- On the Import page, choose the Numerical Matrix and click on Import Selection:



- Now the data is imported in you MATLAB workspace as a matrix with the same name as the downloaded Excel file. You can rename it to whatever name you want. This matrix has the same number of column as the Excel file as well and the corresponding columns are matching.

- Convert the daily data to extract mean monthly temperature, extreme minimum monthly temperature, and extreme maximum monthly temperature. Mind the NaN values that represent missing data. They cannot be replaced by ZERO at all. Consult with the MATLAB help for nanmean and nanstd to learn how to handle datasets with missing values

- To plot your whole time series (related to part 3 of the project), you can use the similar application of the subplot function as shown below for Montreal.

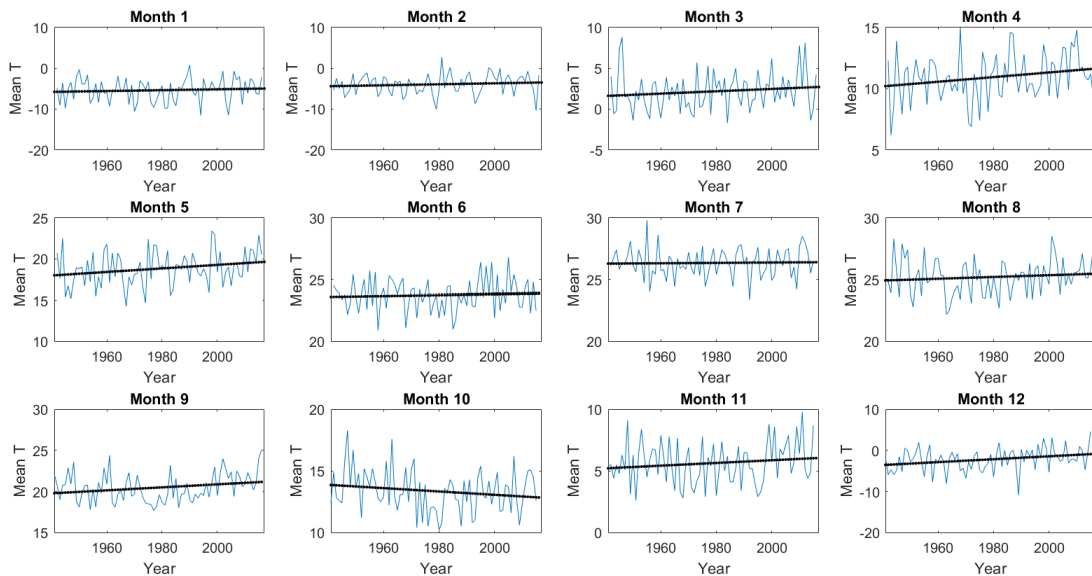


- In order to handle the missing data marked with NaN when creating your table of statistics (related to p4 of the project), you need to filter your data first to remove NaN values and then find the related statistics (e.g. mean, max, etc). Ideally your table should look like this. The following table is related to Montreal.

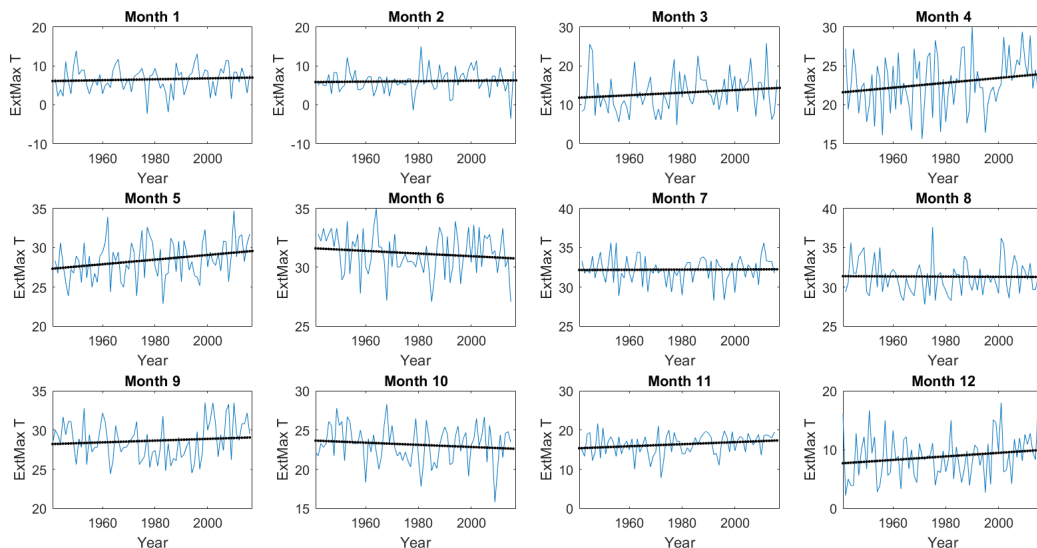
Variable	Month	min	mean	median	mode	max	std
Mean T	Jan	-11.60	-5.38	-5.20	-6.10	0.80	2.83
	Feb	-10.40	-3.93	-3.60	-3.20	2.70	2.44
	Mar	-1.70	2.17	1.70	0.80	8.80	2.33
	Apr	6.20	10.93	11.00	10.40	15.00	1.89
	May	14.30	18.81	18.80	16.70	23.40	2.10
	Jun	20.90	23.75	23.80	23.80	26.80	1.31
	Jul	23.40	26.33	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, you need to get rid of the missing data, marked as NaN, first. For that you should first find the months corresponding to each missing value, and then replace the NaN value with the mean value of the month, which is calculated before for each particular month.
 - 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.

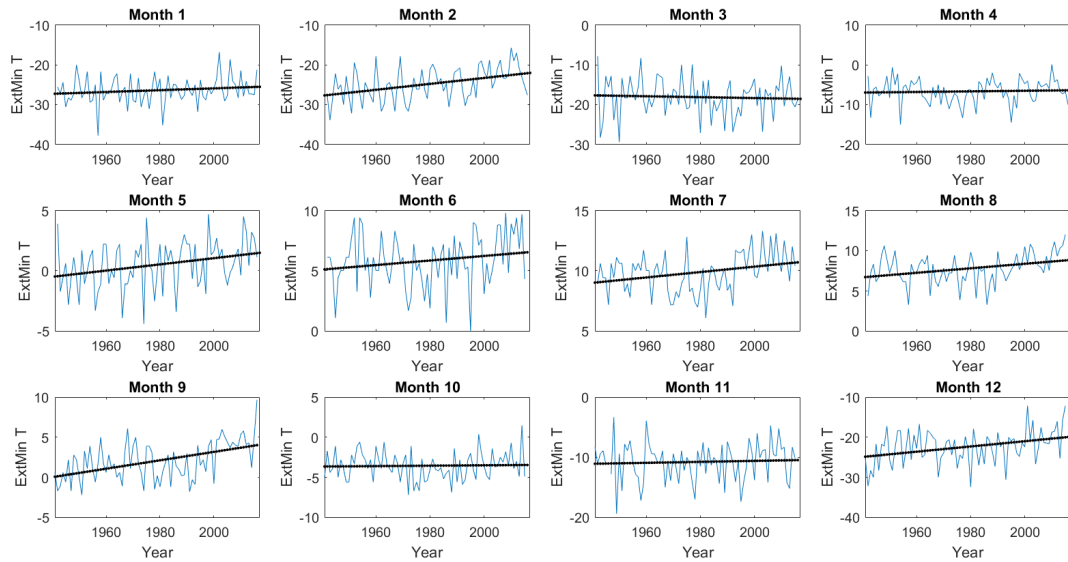
Mean T:



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.