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%%Student name: Lishan Huang
%%Student number: 250777962
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Coding part

```
%{
 *create D1 to read the London_South_Monthly_1883-1932.csv
  and store the data from line 19
 *create D2 to read the London_Lambeth_A_Monthly_1930-1941.csv
  and store the data from line 19
*create D2 to read the London_Intl_Airport_Monthly_1940-2006.csv
  and store the data from line 19
%}
D1 = csvread('London_South_Monthly_1883-1932.csv',19,1);
D2 = csvread('London_Lambeth_A_Monthly_1930-1941.csv',19,1);
D3 = csvread('London_Intl_Airport_Monthly_1940-2006.csv',19,1);
D = [D1(3:end-8,:); D2(29:end-17,:); D3(8:end-50,:)];
%create matrix ylabels to store the data type of each line
ylabels = {'Year','Month','Mean Max Temp (°C)','Mean Min Temp
 (°C)',...
    'Mean Temp (°C)','Extr Max Temp (°C)','Extr Min Temp (°C)',...
    'Total Rain (mm)','Total Snow (cm)','Total Precip (mm)'};
%create matrix titles to store the data type of each line
titles = {'Year','Month','Mean Maximum Temperature (°C)',...
    'Mean Minimum Temperature (°C)','Mean Temperature (°C)',...
    'Extreme Maximum Temp (°C)','Extreme Minimum Temp (°C)',...
    'Total Rain (mm)','Total Snow (cm)','Total Precipitation (mm)'};
% for loop from 3 to 8 print
for i=3:10
    figure
    %store the year and the month into x
    x=D(:,1)+((D(:,2)-1)/12 );
    %plot x and the ith data
    plot(x,D(:,i))
    xlabel('Year')%label x axis
    ylabel(ylabels(i))%label y axis
    title(strcat('London Ontario'," ", titles(i)))%set title with data
 type
    axis tight
    set(gcf,'Position',[100 100 800 400])%set the value x and y axis
    titlevalue=(strcat(titles(i),'.png'));%set the  filename
    m=char(titlevalue);%cast the name to charater
    print('-dpng',m)

end
%the first for loop loop each seasion
% for a from 1 to 3 are spring
% for a from 4 to 7 are summer
% for a from 8 to 10 are autumn
% for a from 11 to 1 are autumn
for(a=1:3:10)
    %second for loop loop each type of data
```

```
   % if c =1 then the data type is the 3rd line in D which is Mean
Maximum Temperature
   % if c =2 then the data type is the 6th line in D which is Extreme
Maximum Temperature
   % if c =3 then the data type is the 7th line in D which is Extreme
Minimum Temperature
   % if c =4 then the data type is the 8th line in D which is Total
Rain
   for(c=1:4)
       %get the number of year;
       n_years = floor(size(D,1)/12);
       if(a==1)
           %if the remainder larger than 3 then there are one more
spring
           if (rem(size(D,1),12) >= 3)
               n_years = n_years+1;
           end
       elseif(a==4)
           %if the remainder larger than 5 then there are one more
summer
           if (rem(size(D,1),12) >= 6)
               n_years = n_years+1;
           end
       elseif(a==7)
           %if the remainder larger than 8 then there are one more
autumn
           if (rem(size(D,1),12) >= 9)
               n_years = n_years+1;
           end
       end
       %put the first year into container years
       years = D(1,1);
       if(c==1)
           % if data type is Mean Maximum Temperature
           % sum up all the temperature and devide it
           if(a==1)
               data = (D(a,3)*31 + D(a+1,3)*30 + D(a+2,3)*31)/
(31+30+31);
           elseif(a==4)
               data = (D(a,3)*30 + D(a+1,3)*31 + D(a+2,3)*31)/
(31+30+31);
           elseif(a==7)
               data =  (D(a,3)*30 + D(a+1,3)*31 + D(a+2,3)*30)/
(31+30+30);
           elseif(a==10)
               %if it is leap year which can be division by 4 then
 the
               %day of February is 29 otherwise is 28
               if(rem(D(first_element,1),4)==0)
                   data =  (D(a,3)*31 + D(a+1,3)*31 + D(a+2,3)*29)/
(31+29+31);
               else
                   data =  (D(a,3)*31 + D(a+1,3)*31 + D(a+2,3)*28)/
(31+28+31);
```

```
                end
            end
        elseif(c==2)
            %if data type is Extreme Maximum Temp
            %then data store maximum Temperature in those three month
            data = max(D(a:a+2,6));
        elseif(c==3)
            %if data type is Extreme Minimum Temp
            %then data store the minimum Temperature in those three
month
            data = min(D(a:a+2,7));
        elseif(c==4)
            %if data type is Total Rain
            %then data store the total precipitation amounts in those
three month
            data = sum(D(a:a+2,8));
        end
        %because the first one already store in years and data
        %then should store the information from the second one
        for i=1:n_years-1
            %get the first month and the last month in each season
            first_element = a+i*12;
            last_element = a+2+i*12;
            if(c==1)%in the first type store the information in 3rd
line
                yrdata = D(first_element:last_element,3);
            elseif(c==2)%in the second type store the information in
6th line
                yrdata = D(first_element:last_element,6);
            elseif(c==3)%in the third type store the information in
7th line
                yrdata = D(first_element:last_element,7);
            elseif(c==4)%in the forth type store the information in
8th line
                yrdata = D(first_element:last_element,8);
            end
            if (~any(isnan(yrdata)))%if the information is not NaN
then store it into data
                years(end+1,1) = D(first_element,1);
                if(c==1)  % if data type is Mean Maximum Temperature
sum up all the temperature and devide it
                    if(a==1)%same as above loop
                        data(end+1,1) = (yrdata(1)*31 + yrdata(2)*30 +
yrdata(3)*31)/(31+30+31);
                    elseif(a==4)
                        data(end+1,1) = (yrdata(1)*30 + yrdata(2)*31 +
yrdata(3)*31)/(31+30+31);
                    elseif(a==7)
                        data(end+1,1) = (yrdata(1)*30 + yrdata(2)*31 +
yrdata(3)*31)/(31+31+30);
                    elseif(a==10)
                        if(rem(D(first_element,1),4)==0)
                            data(end+1,1) = (yrdata(1)*31 +
yrdata(2)*31 + yrdata(3)*31)/(31+31+29);
```

```
                        else
                            data(end+1,1) = (yrdata(1)*31 +
yrdata(2)*31 + yrdata(3)*31)/(31+31+28);
                        end
                    end
                elseif(c==2)% same as above loop
                    data(end+1,1) = max(yrdata) ;
                elseif(c==3)
                    data(end+1,1) = min(yrdata);
                elseif(c==4)
                    data(end+1,1) = sum(yrdata);
                end
            end
        end
        %get the regress function
        [b, bint] = regress(data,[ones(length(years),1),years],0.32);
        if(a==1)%a==1 which months are spring
            name='Spring';
        elseif(a==4)%a==4 which months are summer
            name='Summer';
        elseif(a==7)%a==4 which months are sautumn
            name='Autumn';
        else        %else are winter
            name='Winter';
        end
        % titles(n) and ylabels(n) will be set based on the data type
        if(c==1) %c=1 means the data type is the thrid line
infromation
            n=3; % then read Mean Maximum Temperature
        elseif(c==2)%same as above
            n=6;
        elseif(c==3)
            n=7;
        else
            n=8;
        end
        figure
        plot(years,data) %plot the axis
        axis tight
        hold on
        xlabel('Year')%label axis
        ylabel(ylabels(n))
        title(strcat('London Ontario '," ", name, " ",
titles(n)))%label title
        plot(years,b(2)*years+b(1),'LineWidth',2)
        hold off
        %bint is the inverval of the slope and bint(2,1) is the left
and
        %bint (2,2) is right bound
        left_conf_bound=bint(2,1);%set left confidence bounds
        right_conf_bound=bint(2,2);%set right confidence bounds
        slope=b(2);%set the slope
        if (slope>0)%display accounding to the slope
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```
            disp(strcat('Potential increasing trend for',"
 ",titles(n)," in ",name,' :'))
        elseif (slope<0)
            disp(strcat('Potential decreasing trend for',"
 ",titles(n)," in ",name,' :'))
        end
        if (sign(left_conf_bound) == sign(right_conf_bound))
            disp(' Significant trend at 68% confidence!')
            sigma = abs(slope-left_conf_bound);%set sigma
            fprintf(' Trend is %f +/- %f ',b(2)*100,sigma*100);
            if(c==1 || c==2)%add the unit based on the data type
                fprintf('°C/century\n');
            elseif(c==3)
                fprintf('mm/century\n');
            elseif (c==4)
                fprintf('cm/century\n');
            end%move the inverval with one sigma if still in intersect
 then it is 95% confidenc
            if (sign(left_conf_bound-sigma) == sign(right_conf_bound
+sigma))
                disp(' Significant trend at 95% confidence too!')
            end
        else
            disp(' Trend is not statistically significant')
        end
        disp(' ')
    end
end
```

```
Potential decreasing trend for Mean Maximum Temperature (°C) in
 Spring :
 Trend is not statistically significant

Potential decreasing trend for Extreme Maximum Temp (°C) in Spring :
 Significant trend at 68% confidence!
 Trend is -0.685356 +/- 0.624909 °C/century

Potential increasing trend for Extreme Minimum Temp (°C) in Spring :
 Significant trend at 68% confidence!
 Trend is 3.092492 +/- 1.180095 mm/century
 Significant trend at 95% confidence too!

Potential increasing trend for Total Rain (mm) in Spring :
 Significant trend at 68% confidence!
 Trend is 21.506631 +/- 15.633218 cm/century

Potential decreasing trend for Mean Maximum Temperature (°C) in
 Summer :
 Significant trend at 68% confidence!
 Trend is -0.849672 +/- 0.328500 °C/century
 Significant trend at 95% confidence too!

Potential decreasing trend for Extreme Maximum Temp (°C) in Summer :
 Significant trend at 68% confidence!
```

```
 Trend is -1.437890 +/- 0.572896 °C/century
 Significant trend at 95% confidence too!

Potential increasing trend for Extreme Minimum Temp (°C) in Summer :
 Significant trend at 68% confidence!
 Trend is 1.920182 +/- 0.487916 mm/century
 Significant trend at 95% confidence too!

Potential increasing trend for Total Rain (mm) in Summer :
 Trend is not statistically significant

Potential decreasing trend for Mean Maximum Temperature (°C) in
 Autumn :
 Significant trend at 68% confidence!
 Trend is -0.419282 +/- 0.329897 °C/century

Potential decreasing trend for Extreme Maximum Temp (°C) in Autumn :
 Significant trend at 68% confidence!
 Trend is -1.768338 +/- 0.626831 °C/century
 Significant trend at 95% confidence too!

Potential increasing trend for Extreme Minimum Temp (°C) in Autumn :
 Significant trend at 68% confidence!
 Trend is 1.838912 +/- 0.945330 mm/century

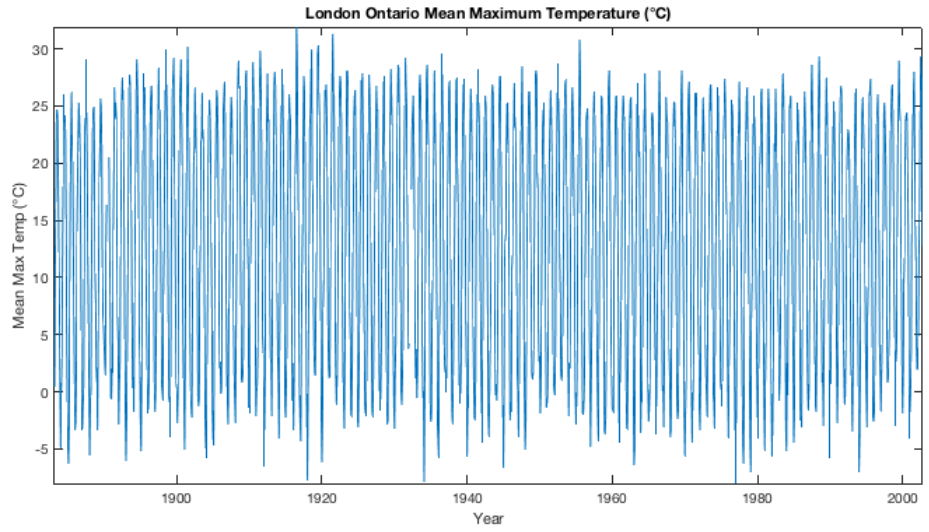
Potential increasing trend for Total Rain (mm) in Autumn :
 Significant trend at 68% confidence!
 Trend is 45.761501 +/- 17.854075 cm/century
 Significant trend at 95% confidence too!

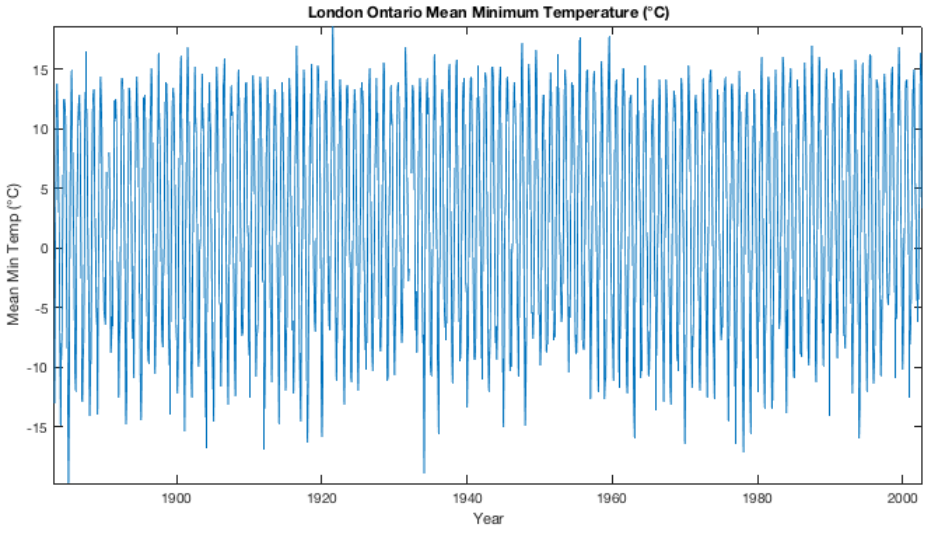
Potential increasing trend for Mean Maximum Temperature (°C) in
 Winter :
 Trend is not statistically significant

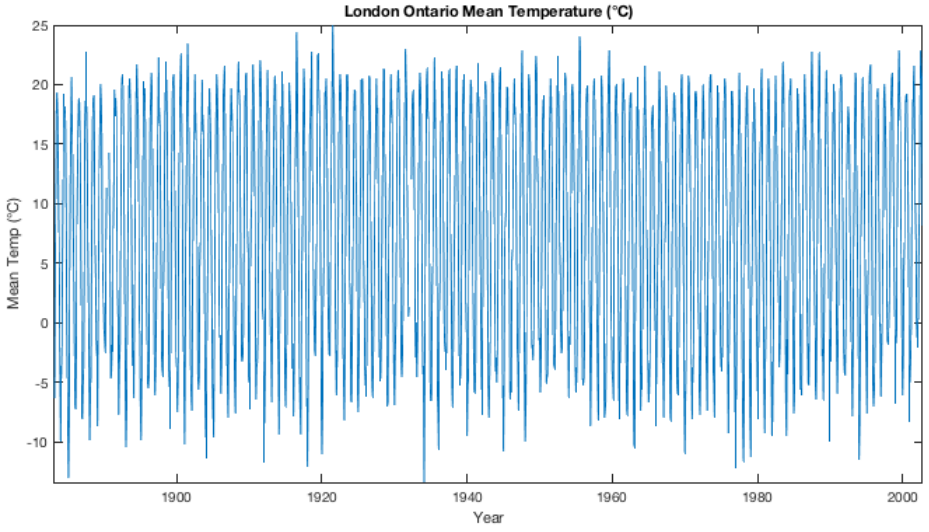
Potential increasing trend for Extreme Maximum Temp (°C) in Winter :
 Significant trend at 68% confidence!
 Trend is 1.228510 +/- 0.730083 °C/century

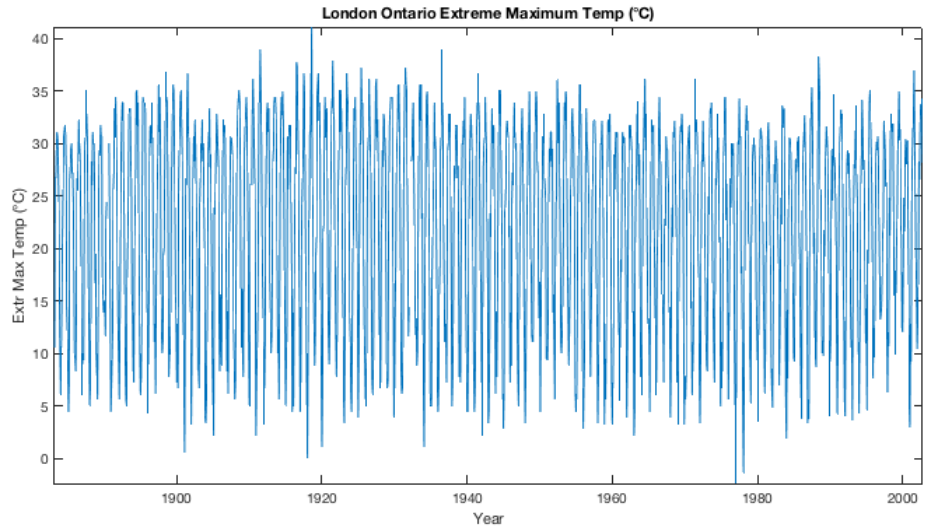
Potential increasing trend for Extreme Minimum Temp (°C) in Winter :
 Significant trend at 68% confidence!
 Trend is 4.025622 +/- 0.985758 mm/century
 Significant trend at 95% confidence too!

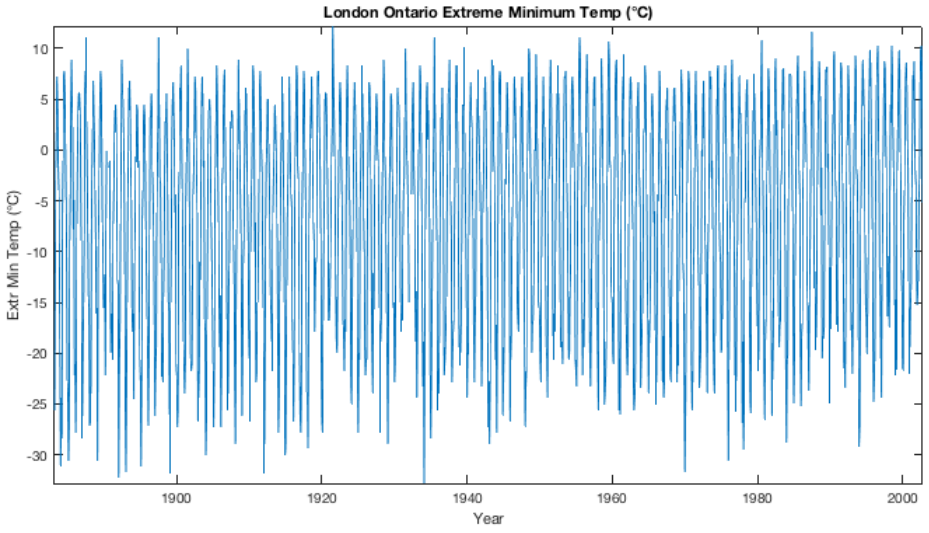
Potential decreasing trend for Total Rain (mm) in Winter :
 Trend is not statistically significant
```

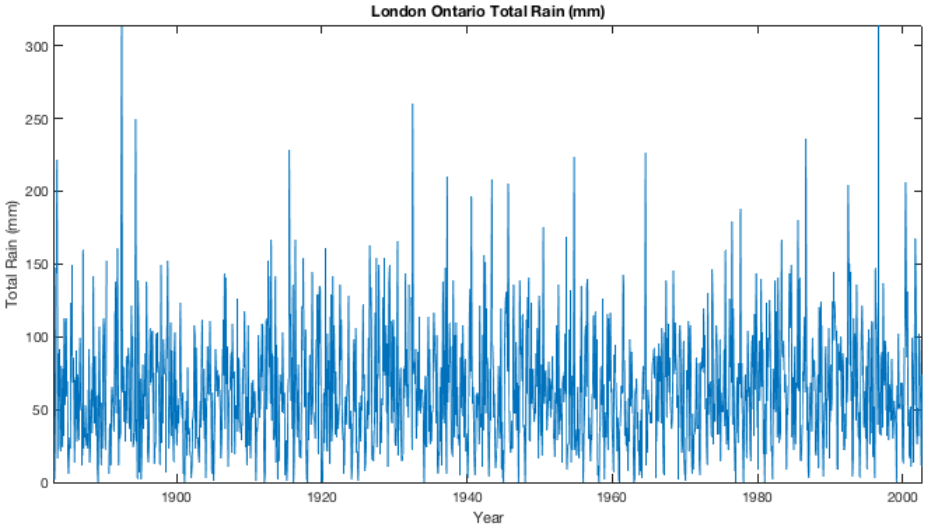

London Ontario Mean Maximum Temperature (°C)
Mean Max Temp (°C)
30
25
20
15
10
5
0
-5
1900
1920
1940
1960
1980
2000
Year

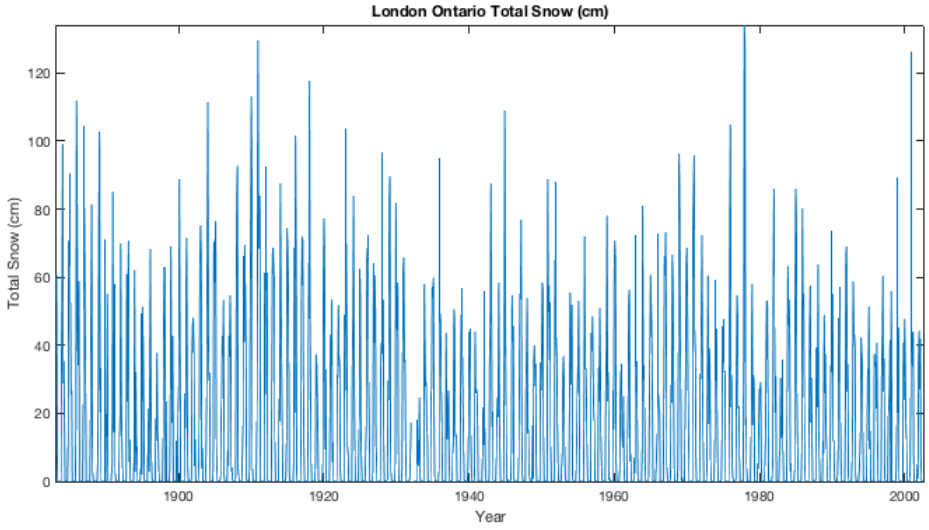

London Ontario Mean Minimum Temperature (°C)
Mean Min Temp (°C)
15
10
5
0
-5
-10
-15
1900
1920
1940
1960
1980
2000
Year

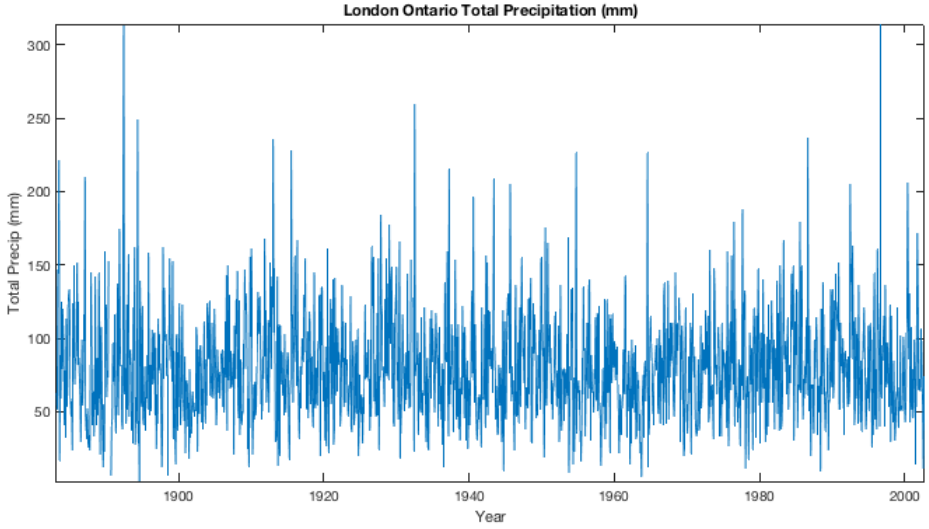

London Ontario Mean Temperature (°C)
Mean Temp (°C)
25
20
15
10
5
0
-5
-10
1900
1920
1940
1960
1980
2000
Year

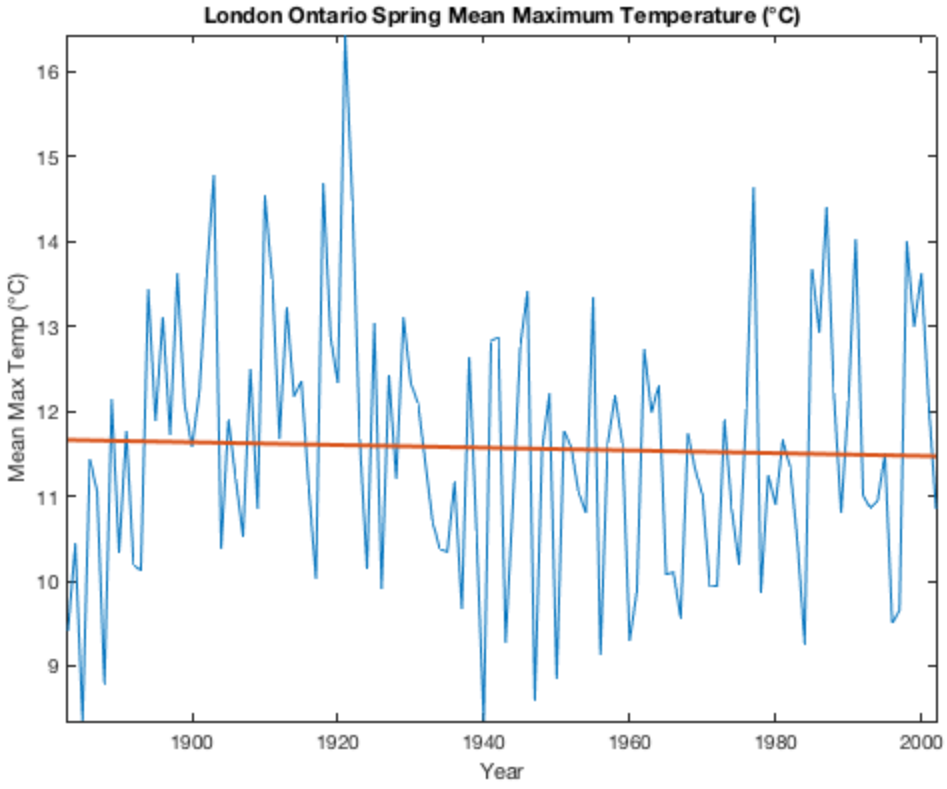

London Ontario Extreme Maximum Temp (°C)
Extr Max Temp (°C)
40
35
30
25
20
15
10
5
0
1900
1920
1940
1960
1980
2000
Year

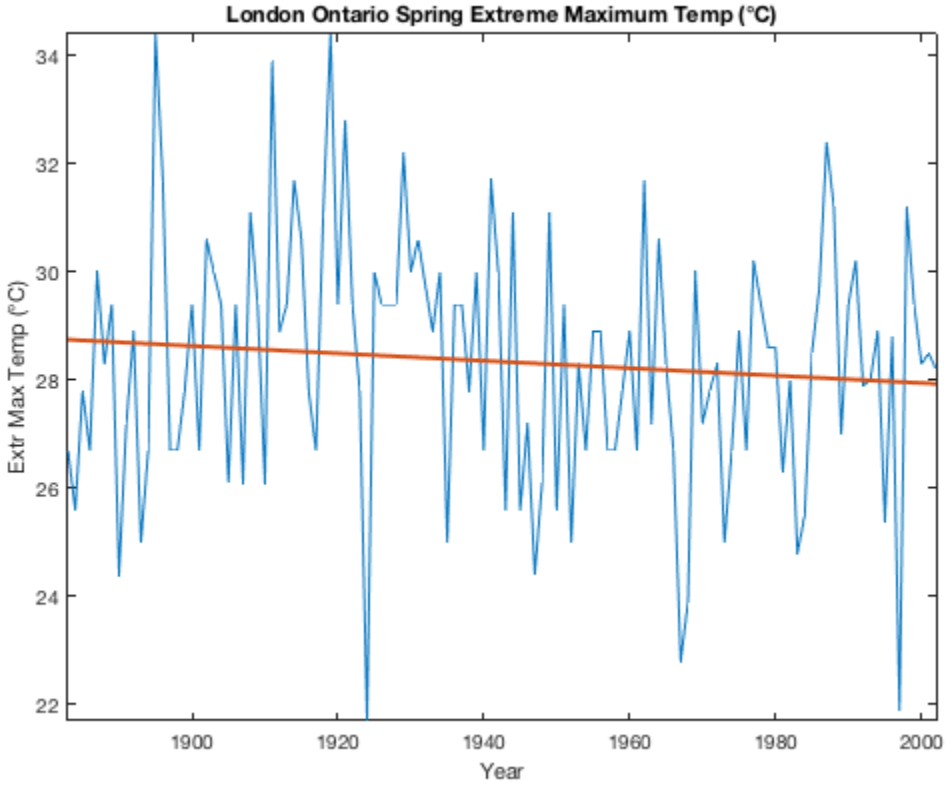

London Ontario Extreme Minimum Temp (°C)
Extr Min Temp (°C)
10
5
0
-5
-10
-15
-20
-25
-30
1900
1920
1940
1960
1980
2000
Year

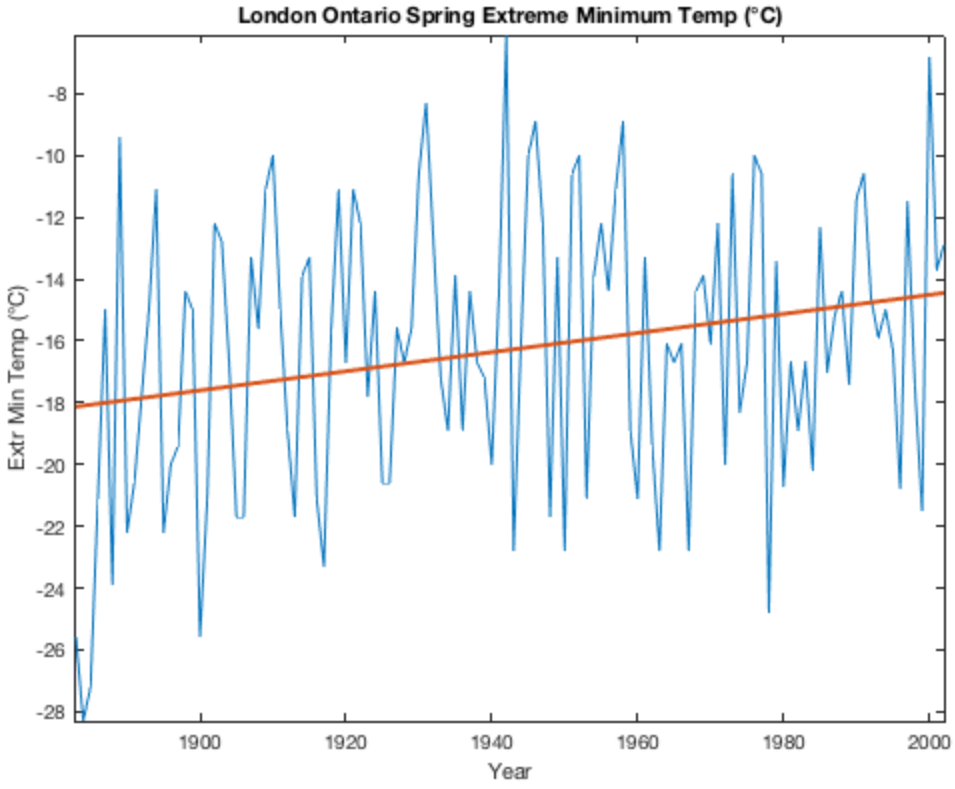

London Ontario Total Rain (mm)
Total Rain (mm)
300
250
200
150
100
50
0
1900
1920
1940
1960
1980
2000
Year

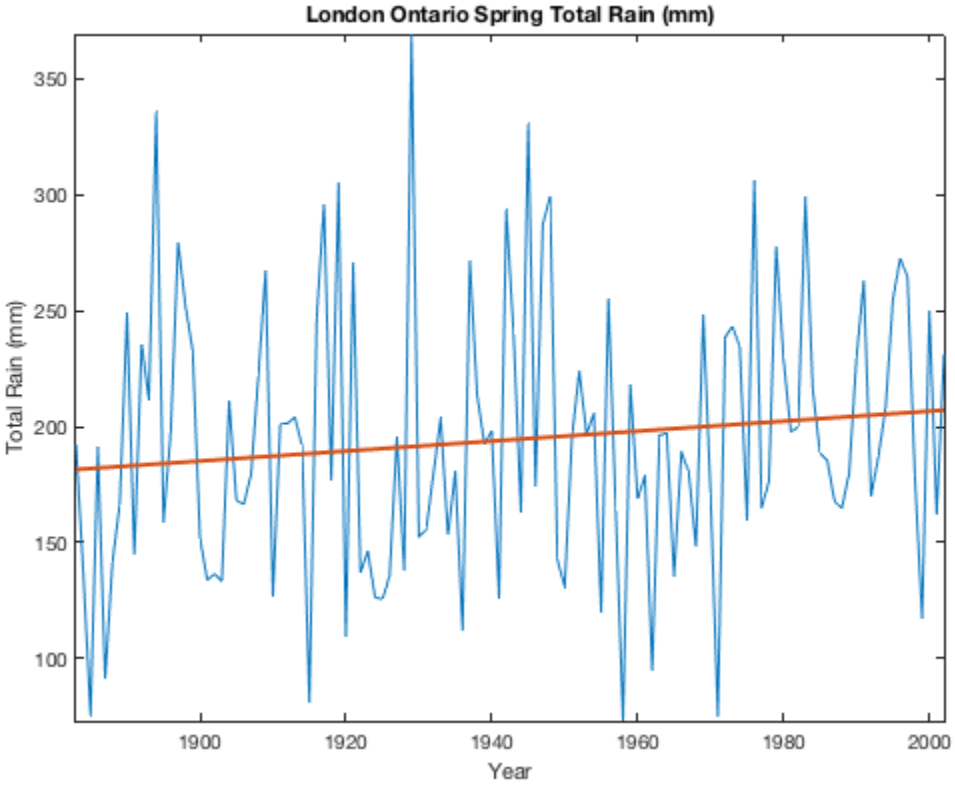

London Ontario Total Snow (cm)
Total Snow (cm)
0
20
40
60
80
100
120
1900
1920
1940
1960
1980
2000
Year

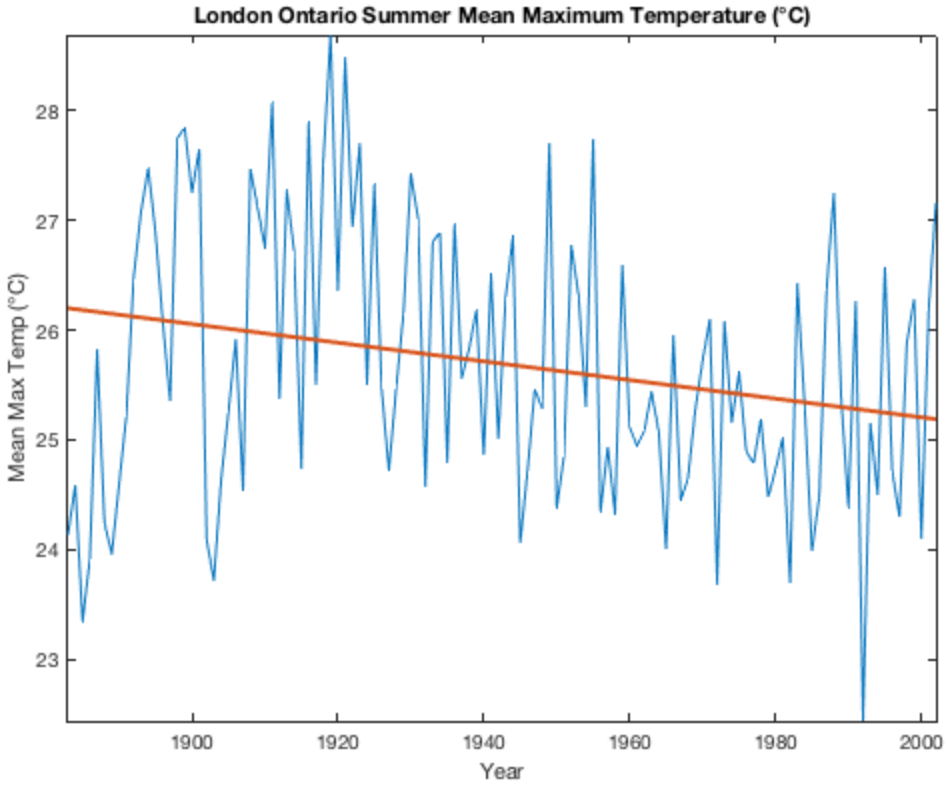

London Ontario Total Precipitation (mm)
Total Precip (mm)
50
100
150
200
250
300
1900
1920
1940
1960
1980
2000
Year

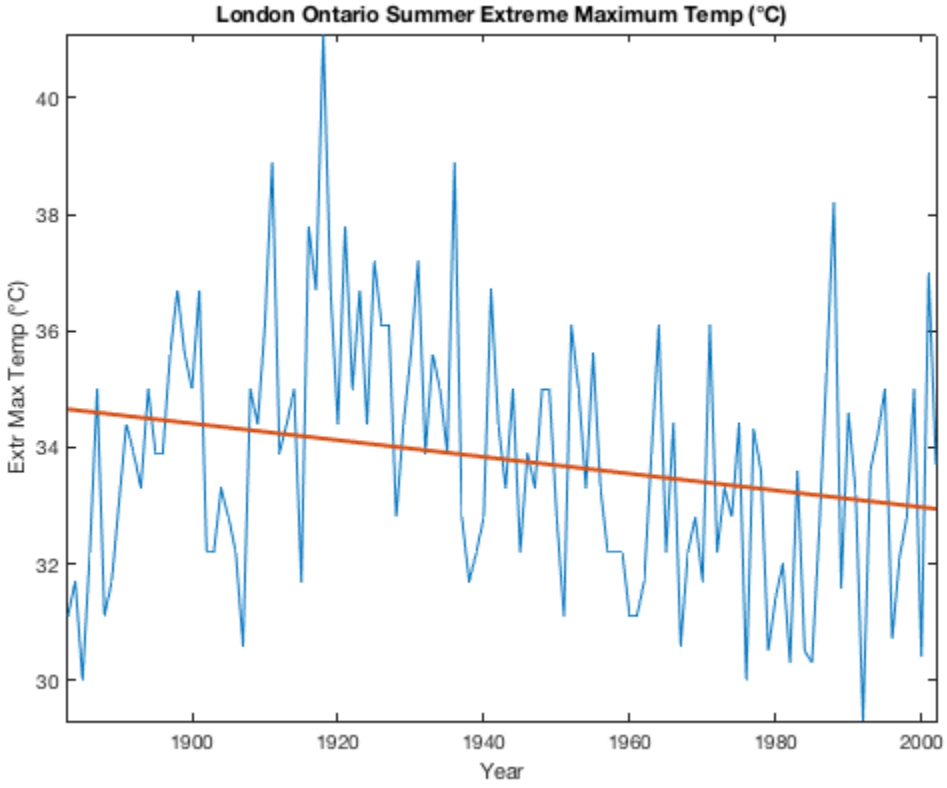

London Ontario Spring Mean Maximum Temperature (°C)
Mean Max Temp (°C)
16
15
14
13
12
11
10
9
1900
1920
1940
1960
1980
2000
Year

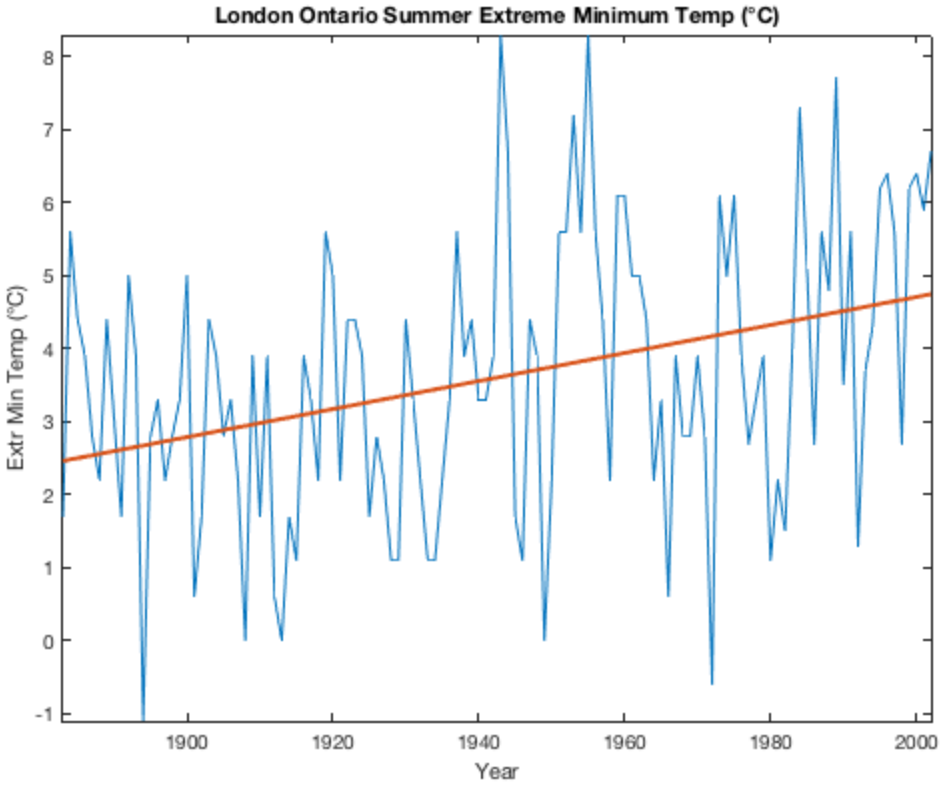

London Ontario Spring Extreme Maximum Temp (°C)
Extr Max Temp (°C)
34
32
30
28
26
24
22
1900
1920
1940
1960
1980
2000
Year

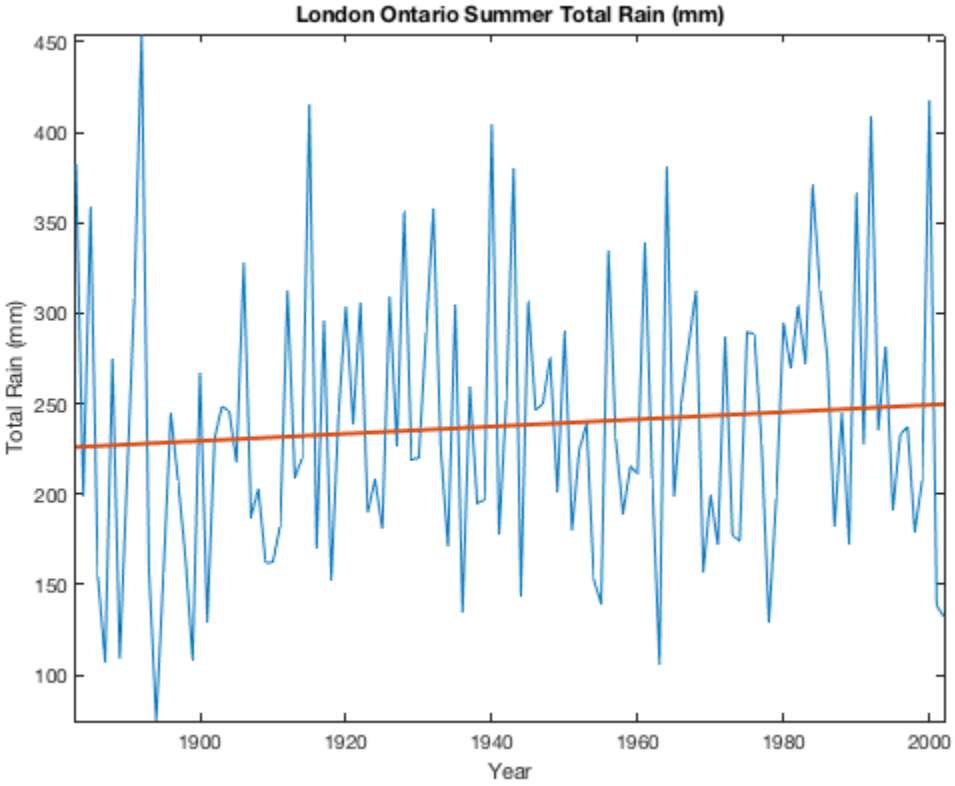

London Ontario Spring Extreme Minimum Temp (°C)
Extr Min Temp (°C)
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
1900
1920
1940
1960
1980
2000
Year

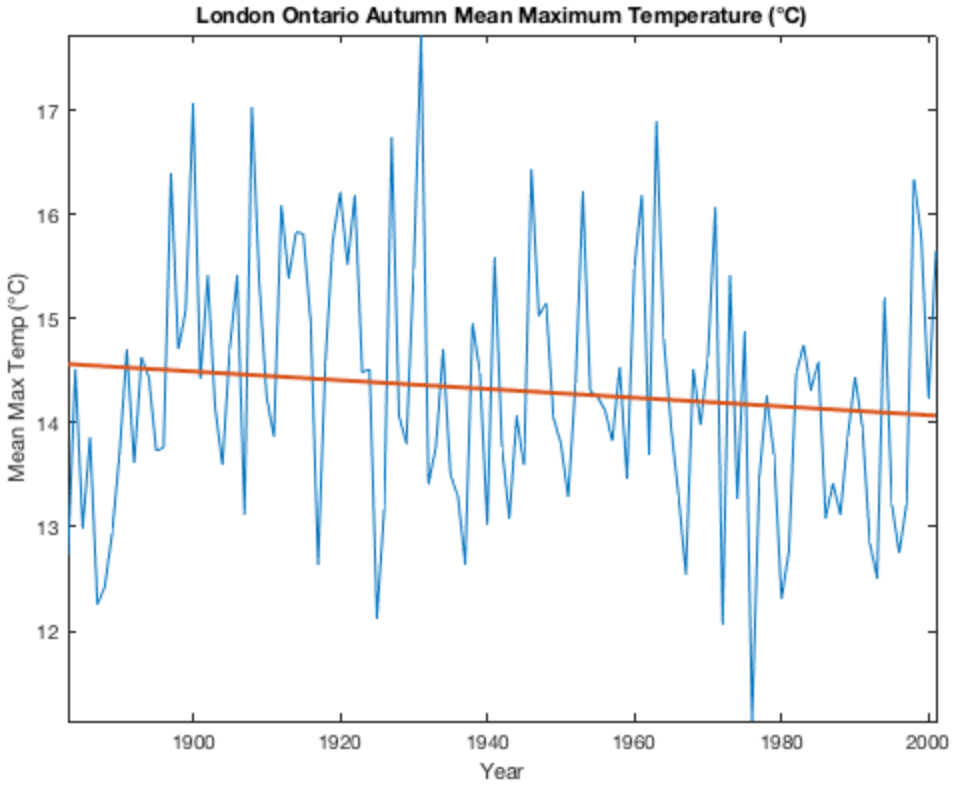

London Ontario Spring Total Rain (mm)
Total Rain (mm)
350
300
250
200
150
100
1900
1920
1940
1960
1980
2000
Year

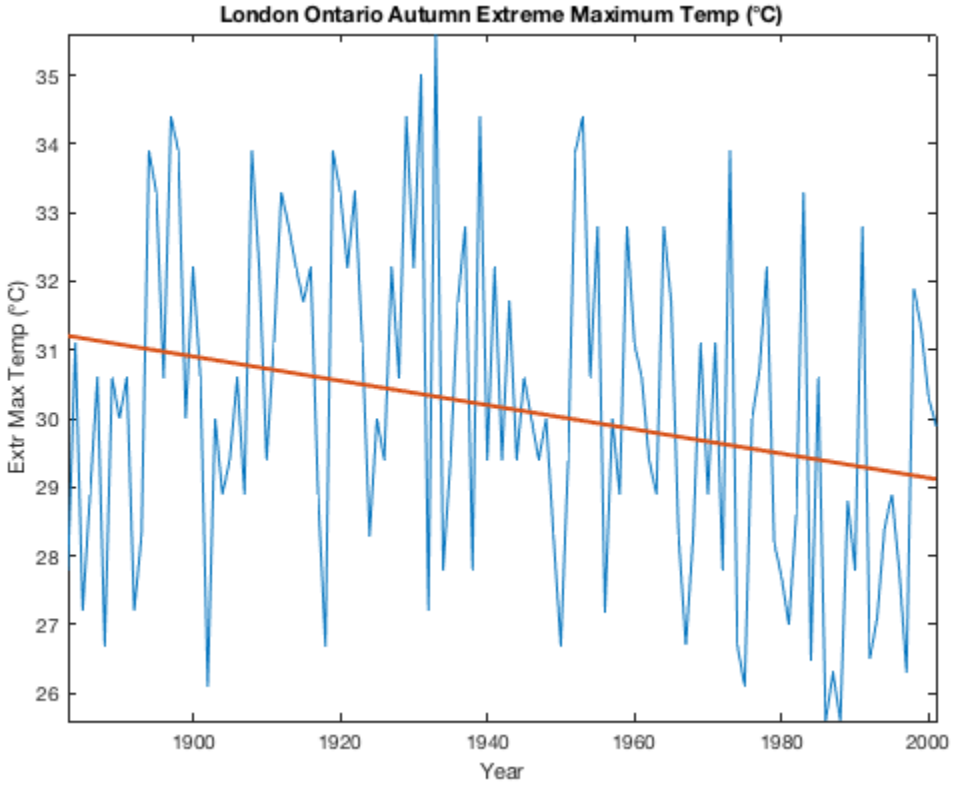

London Ontario Summer Mean Maximum Temperature (°C)
Mean Max Temp (°C)
28
27
26
25
24
23
1900
1920
1940
1960
1980
2000
Year

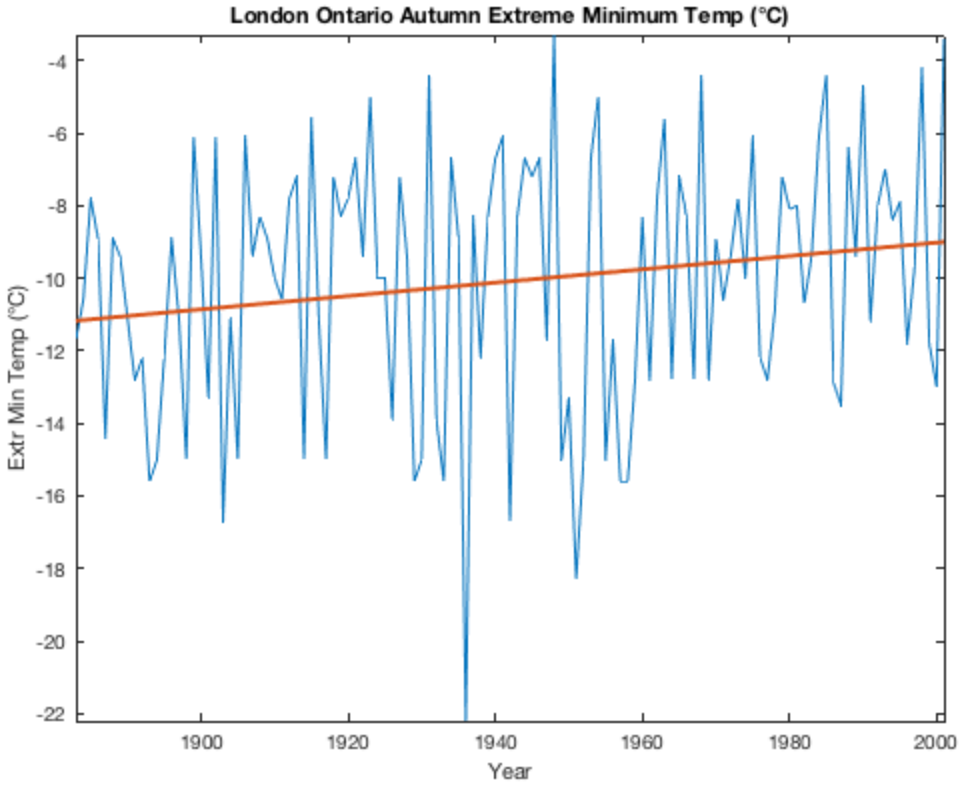

London Ontario Summer Extreme Maximum Temp (°C)
Extr Max Temp (°C)
40
38
36
34
32
30
1900
1920
1940
1960
1980
2000
Year

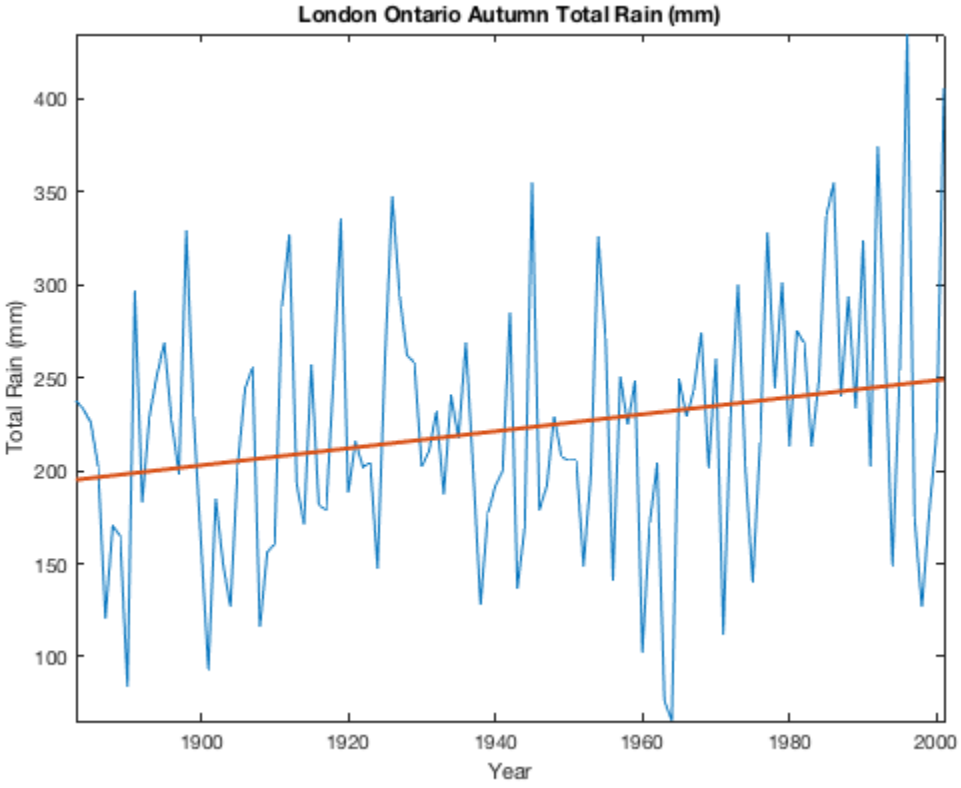

London Ontario Summer Extreme Minimum Temp (°C)
Extr Min Temp (°C)
8
7
6
5
4
3
2
1
0
-1
1900
1920
1940
1960
1980
2000
Year

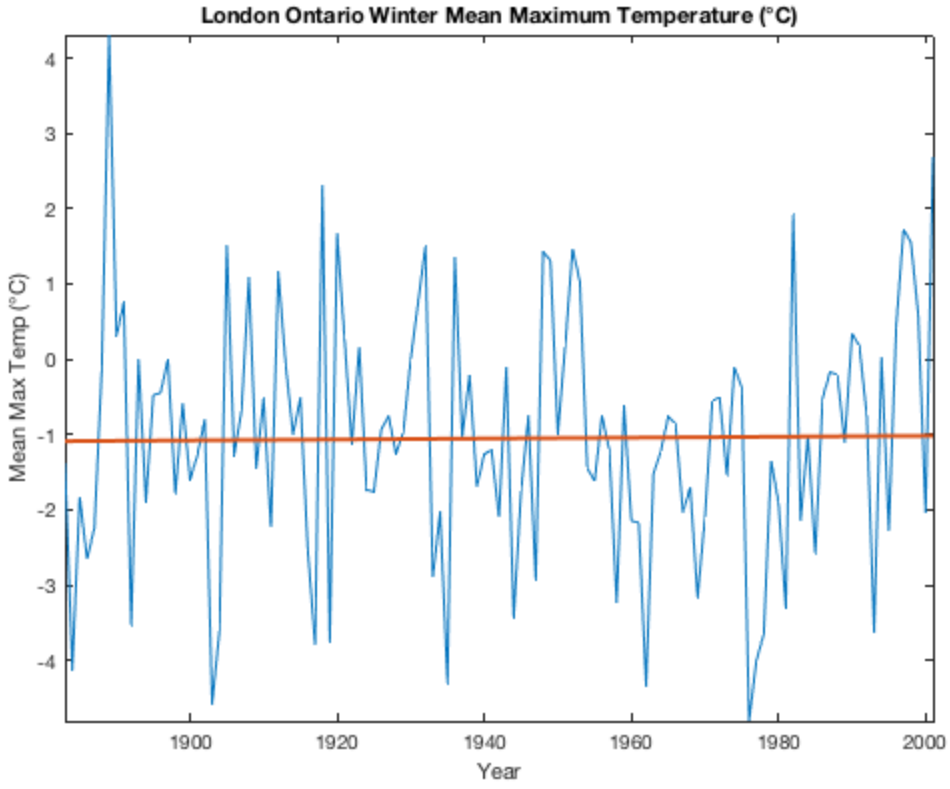

London Ontario Summer Total Rain (mm)
Total Rain (mm)
450
400
350
300
250
200
150
100
1900
1920
1940
1960
1980
2000
Year

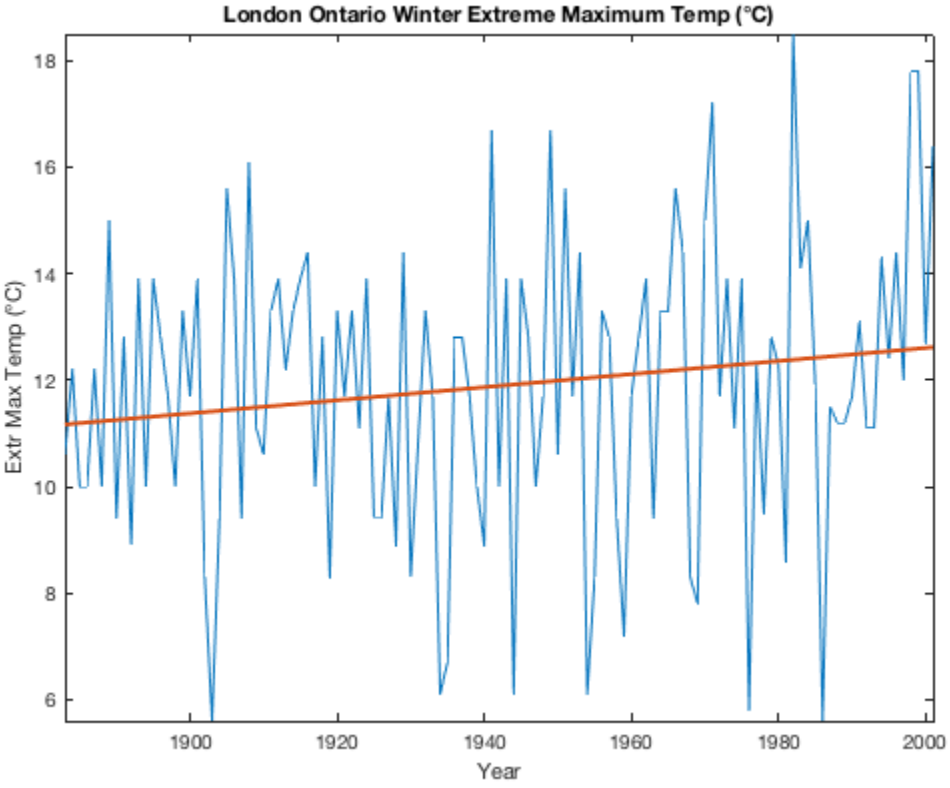

London Ontario Autumn Mean Maximum Temperature (°C)
Mean Max Temp (°C)
17
16
15
14
13
12
1900
1920
1940
1960
1980
2000
Year

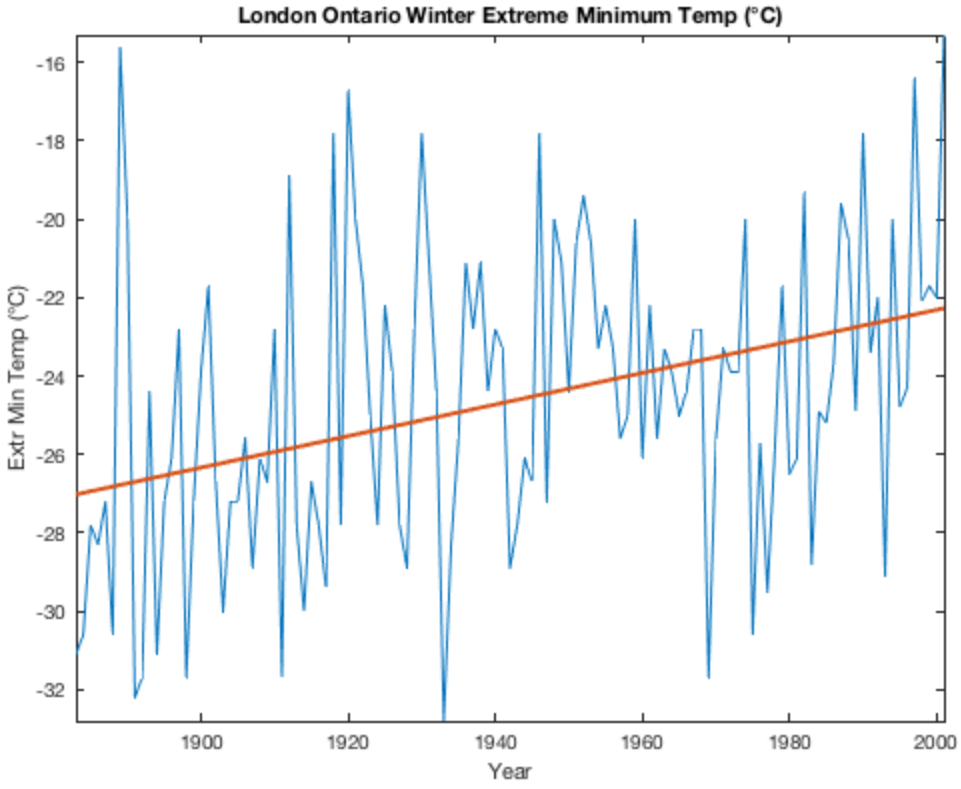

London Ontario Autumn Extreme Maximum Temp (°C)
Extr Max Temp (°C)
35
34
33
32
31
30
29
28
27
26
1900
1920
1940
1960
1980
2000
Year

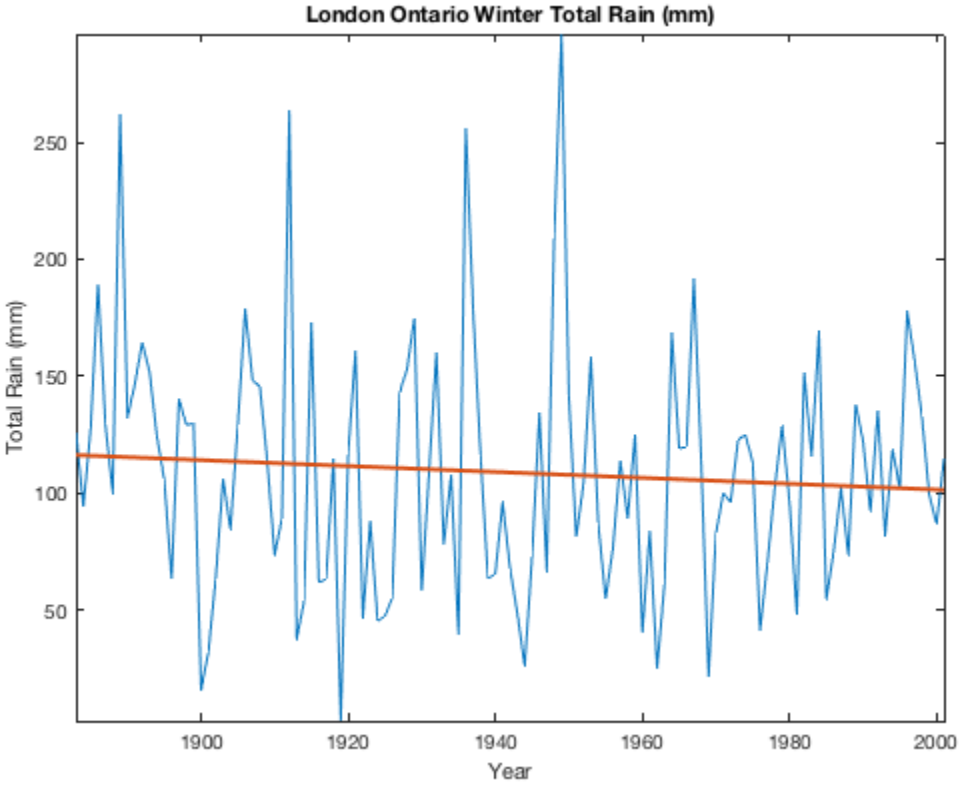

London Ontario Autumn Extreme Minimum Temp (°C)
Extr Min Temp (°C)
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
1900
1920
1940
1960
1980
2000
Year


London Ontario Autumn Total Rain (mm)
Total Rain (mm)
400
350
300
250
200
150
100
1900
1920
1940
1960
1980
2000
Year


London Ontario Winter Mean Maximum Temperature (°C)
Mean Max Temp (°C)
4
3
2
1
0
-1
-2
-3
-4
1900
1920
1940
1960
1980
2000
Year


London Ontario Winter Extreme Maximum Temp (°C)
Extr Max Temp (°C)
18
16
14
12
10
8
6
1900
1920
1940
1960
1980
2000
Year


London Ontario Winter Extreme Minimum Temp (°C)
Extr Min Temp (°C)
-16
-18
-20
-22
-24
-26
-28
-30
-32
1900
1920
1940
1960
1980
2000
Year


London Ontario Winter Total Rain (mm)
Total Rain (mm)
250
200
150
100
50
1900
1920
1940
1960
1980
2000
Year

Discussion of Results

```
%%Spring:
%decreasing trend for Mean Maximum Temperature (°C)
%decreasing trend for Extreme Maximum Temp
      %Significant trend at 68% confidence!
%increasing trend for Extreme Minimum Temp (°C)
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!
%increasing trend for Total Rain (mm)
      % Significant trend at 68% confidence!


%%Summer:
%decreasing trend for Mean Maximum Temperature (°C)
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!
%decreasing trend for Extreme Maximum Temp (°C)
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!
%increasing trend for Extreme Minimum Temp
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!
%increasing trend for Total Rain (mm)


%%Autumn
%decreasing trend for Mean Maximum Temperature (°C)
      % Significant trend at 68% confidence!
%decreasing trend for Extreme Maximum Temp (°C)
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!
%increasing trend for Extreme Minimum Temp (°C)
      %Significant trend at 68% confidence!
%increasing trend for Total Rain (mm)
      %Significant trend at 68% confidence!
      %Significant trend at 95% confidence too!


%%Winter
%increasing trend for Mean Maximum Temperature (°C)
%increasing trend for Extreme Maximum Temp (°C)
     %Significant trend at 68% confidence!
%increasing trend for Extreme Minimum Temp (°C)
     %Significant trend at 68% confidence!
     %Significant trend at 95% confidence too!
%decreasing trend for Total Rain (mm)

%%assessment:
% In winter and spring the extre maximum temperature were increasing
% in past 100 years, but the extre maximum temperature were decreasing
% in summer and autumn. The Extreme Minimum temperature were
 increasing
```

```
% in past 100 years, and the total railfall was changed significantly
% Thus what we can predict is the extreme minimum temperature will be
% increasing in the future.
```

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