**Note:** Present the results as a word file by importing the figures that you created using your matlab code and saving your output figures as .png or .jpeg graphic formats. Plot figure title for every figure as: Figure 1, Figure 2, etc. using the matlab function ‘Title’. Turn in your homework as one word file named “hmw#\_studentname.docx” which includes code and output figures for each problem and attach this file to a blackboard message writing “hmw#” in the subject line.

1. Data preparation:
   1. Download from the web the text-format dataset of sea surface temperature (SST) time series (see the given data\_info word file for a link to the online dataset) into your computer and name the file “data.txt”.
   2. Use the text editor to delete the header (first line of text) so that the data contains only numbers that can be easily uploaded into matlab using the matlab command load.
   3. Use the text editor to delete the last few lines so that the last line that remains in the dataset is December 2018 (i.e., we will work with only complete years up to and including December 2018).
2. Create a simple time series plot (a helpful tutorial illustrating how to import a dataset into matlab, perform simple calculations and plots, and export the results in text forma can be found at <https://youtu.be/E56egH10RJA>)
   1. Using the dataset of sea surface temperature (SST) time series given in text format that was generated in (1) and named data.txt, extract the Nino3 index (5th column) and make a time series plot of Nino3 (y-axis) vs time (x-axis) by using a time vector of integer month numbers from 1 to N (where N is the max number of months in the dataset) as a blue solid line.
   2. Labe x-axis as ‘Time (months)’ and y-axis as ‘SST (deg C)’.
   3. Overlay a plot of Nino3.4 as a red dashed line. Use a y-axis range of [ymin, ymax]=[22, 30].
   4. Plot a legend to indicate Nino3 and Nino3.4 curves.
   5. Calculate and report the values of the max, min, and range (max-min) for both Nino3 and Nino3.4 using the matlab functions ‘max’ and ‘min’.
   6. Plot black asterisk symbols (\*) in the max and min values of the function Nino3.

A screenshot of a cell phone

Description automatically generated

1. Compute a 2-panel plot of histograms of Nino3 using the matlab function ‘histogram’
   1. Top panel: Use default binning, label the x axis as ‘Temperature (deg C)’ and the y axis as ‘Frequency’.
   2. Bottom panel: Same as top panel but using half the bin size

A picture containing music

Description automatically generated

1. Create a scatter plot of Nino3.4 (y-axis) vs Nino3 (x-axis).
   1. Set both axes ranges between 24 and 30 deg C using the matlab function ‘axis’.
   2. Based on this figure, which index is typically warmer?

A close up of a map

Description automatically generated

1. Create a 1-panel time series plot of SST **anomalies** by overlaying Nino3 (solid blue line) and Nino3.4 (dashed red line). Plot a legend to indicate Nino3 and Nino3.4 curves.

A screenshot of a cell phone

Description automatically generated

1. Create a 1 panel plot as in problem 5 but for the seasonal cycles constructed from the difference time series between SST and SST anomalies (SST minus SST anomaly) for both Nino3 and Nino3.4. Use a y-axis range of [22,30].

A screenshot of a cell phone

Description automatically generated

1. Create a map of the world using routine ‘coastmap(V,DXDY,Fill)’ with boundaries V=[0 360 -60 60], tick marks DXDY=40 and grey colored continents using Fill=’fill’. Using the function boxdraw draw the boundaries of the Nino3 region (blue solid) and Nino3.4 (red dashed). Try the provided functions landscape and portrait to see which one gives you better results in displaying your figure.

A close up of a map

Description automatically generated

Matlab Code

|  |  |
| --- | --- |
|  |  |
|  |  | %1)load the data  load data.txt; |
|  |  | i=transpose(1:828); |
|  |  | nino\_3=data(:,5); |
|  |  | nino3\_4=data(:,9); |
|  |  |  |
|  |  | %2)plot nino3 vs.time vector |
|  |  | plot(i,nino\_3,'Color','blue'); |
|  |  | xlabel('Time(months)') |
|  |  | ylabel('SST(deg C)') |
|  |  | hold on |
|  |  | plot(i,nino3\_4,'--','Color','red') |
|  |  | ylim([22,30]) |
|  |  |  |
|  |  | [max\_nino3,index\_max\_nino3]=max(nino\_3); |
|  |  | [max\_nino34,index\_max\_nino34]=max(nino3\_4); |
|  |  | [min\_nino3,index\_min\_nino3]=min(nino\_3); |
|  |  | [min\_nino34,index\_min\_nino34]=min(nino3\_4); |
|  |  | range\_nin03=max\_nino3-min\_nino3; |
|  |  | range\_nin034=max\_nino34-min\_nino34; |
|  |  |  |
|  |  | %2)plot the max and min values for nino3 |
|  |  | hold on |
|  |  | plot(index\_max\_nino3,max\_nino3,'\*','Color','black') |
|  |  | plot(index\_min\_nino3,min\_nino3,'\*','Color','black') |
|  |  | legend('nino3','nino3.4','max','min') |
|  |  | title('Figure 1') |
|  |  |  |
|  |  | % 3)compute a 2-panel plot of histogram of Nino3 using Matlab function |
|  |  | % histogram |
|  |  | figure |
|  |  | sgtitle('Figure 2') |
|  |  | subplot(2,1,1); |
|  |  | histogram(nino\_3); |
|  |  | xlabel('Temperature(deg C)'); |
|  |  | ylabel('Frequency'); |
|  |  | subplot(2,1,2); |
|  |  | histogram(nino\_3,28); |
|  |  | xlabel('Temperature(deg C)'); |
|  |  | ylabel('Frequency'); |
|  |  |  |
|  |  |  |
|  |  | %4)Create a scatter plot of Nino3.4(y-axis) vs Nino3(x-axis) |
|  |  | figure |
|  |  | scatter(nino\_3,nino3\_4); |
|  |  | axis([24 30 24 30]) |
|  |  | xlabel('Nino3 Temperature'); |
|  |  | ylabel('Nino 3.4 Temperature'); |
|  |  | title('Figure 3'); |
|  |  |  |
|  |  | %5) Create a one panel time series of SST anomalies |
|  |  | figure |
|  |  | nino\_3\_anom=data(:,6); |
|  |  | nino3\_4\_anom=data(:,10); |
|  |  | b1=plot(i,nino\_3\_anom,'Color','blue'); |
|  |  | hold on |
|  |  | b2=plot(i,nino3\_4\_anom,'--','Color','red'); |
|  |  | legend('nino3 anomalies','nino3.4 anomalies'); |
|  |  | xlabel('Time(months)') |
|  |  | ylabel('Temperature(deg C)') |
|  |  | title('Figure 4'); |
|  |  |  |
|  |  | %6) Create a one figure seasonal cycle from difference |
|  |  | figure |
|  |  | diff\_nino3=nino\_3-nino\_3\_anom; |
|  |  | diff\_nino3\_4=nino3\_4-nino3\_4\_anom; |
|  |  | plot(i,diff\_nino3,i,diff\_nino3\_4) |
|  |  | ylim([22,30]) |
|  |  | xlabel('Time(months)') |
|  |  | ylabel(' difference SST(deg C)') |
|  |  | title('Figure 5'); |
|  |  |  |
|  |  | %7)Create a map of the world using coastmap |
|  |  | figure |
|  |  | landscape(); |
|  |  | coastmap([0 360 -60 60],40,'fill'); |
|  |  | boxdraw([210,270,-5,5],'blue'); |
|  |  | boxdraw([190,240,-5,5],'red','r--'); |
|  |  | %legend('Nino 3','Nino 3.4') |
|  |  | title('Figure 6'); |