MATLAB Bootcamp – Homework 3

Save your code in a .m file (e.g. HW3.m). Add comments by including `%` signs before any text you want MATLAB to ignore. You are not obligated to submit anything to me, but if you want to check your answers you can email me your code and I will have a look at it. Also, feel free to contact me if you have any problems! kdrushka@ucsd.edu

Download argo_profiles.mat from the class website (http://www-pord.ucsd.edu/~kdrushka/matlab/argo_profiles.mat). The matrices **`T`** and **`S`** contain temperature and salinity measurements from 109 Argo profiles, with each column of the matrices representing the data from one profile. Each profile corresponds to a single time, lat, and lon, so time, lat, and lon are all vectors of length 109. Each profile is also associated with a set of depths, which are given by the matrix **`z`**, which has the same dimensions as **`T`** and **`S`** . For example, the first profile was made at `time(1)` at the location `lon(1), lat(1)`, and has the temperature values `T(:,1)` and salinity values `S(:,1)`, which were measured at depths `z(:,1)`. `z(1,:)` represents the shallowest depth of each of the profiles.

1. The goal of this question is to look at near-surface temperature. Although Argo floats don't come all the way up to the sea surface, they get within a few meters; here, we will look at the shallowest Argo measurements.
    a. Plot the shallowest temperature measurement for each profile as a function of time (hint: the shallowest temperatures are in the first row of the temperature matrix). Use the **`datetick`** function to label the x-axis.
    b. What is the time range of these data? What is the average time difference between adjacent profiles (hint, use the command **`diff`**).
    c. What is the range of the shallowest temperatures?
    d. What is the average depth of the shallowest measurement (i.e. average the first row of `z` across all profiles).
2. Whereas temperature generally decreases monotonically with depth, salinity can have a subsurface maximum. The goal of this question is to determine the depth of the subsurface salinity maximum from a bunch of Argo profiles. (Note, most Argo floats go down to ~1000 or 2000m depth, but these only go down to around 200m because they were part of a special project to sample the mixed layer at high resolution).
    a. Run through each of the 109 profiles using a **`for`** loop.
    b. For each profile, calculate the maximum salinity using the command **`max`**. Specify two outputs for the **`max`** command: the first output is the maximum value, and the second output is the index of that maximum (see **`help max`** for more information). Use the index of the maximum to also calculate the depth at which salinity is maximum.
    c. Store the maximum salinity value for each profile in a new vector called `Smax`. e.g. for the k^{th} profile, store the max salinity value in **`Smax(k)`** ; once you have run though the for loop, `Smax` should have the length 109.
    d. Similarly, store the depth of the salinity maximum for each profile. E.g. for the k^{th} profile, store the max-salinity-depth in **`Smax_depth(k)`**.
    e. Plot the maximum salinity () against max-salinity-depth (**`Smax_depth`**), as a scatterplot (i.e. don't use a line, just use markers).
    f. Use regress to fit a line to data: **`Smax_depth`** should be the independent variable (i.e. "x" in the linear fit), and **`Smax`** should be the dependent variable ("y" in the fit). Be sure to include a column of ones in the fitting matrix to account for the fact that the line doesn't go through zero. Do you think this is actually a linear relationship?
    g. Calculate the mean, median, maximum, and minimum of the maximum salinity depth.