

Problem Set 1: MAE 127

due Friday, April 8, 2005

1. Matlab is going to be an important tool for this course. Get yourself set up to use Matlab either on a UCSD computer or at home. If you don't have much Matlab experience, run the Matlab tutorial located at:

http://www.mathworks.com/academia/student_center/tutorials/launchpad.html.

If you have used Matlab before and think the tutorial is old hat, then take this as an opportunity to learn about some aspect of Matlab with which you are unfamiliar, either by reading Matlab help pages or working through another tutorial.

Either way, write a paragraph describing what you did, what you found interesting, and what was most helpful.

Of 16 problems sets received, 4 people implied they were relatively new to Matlab, 8 said they had Matlab experience but did the tutorial, 2 indicated that they had used help pages to learn more about Matlab, and 2 did not specify what they had done.

2. The rest of this problem set will look at temperature data from a buoy in the Santa Monica Basin. First access the data from the course computer system:

`ieng9.ucsd.edu:me127s/public/hw1`

or download the data from the course website:

`http://www-pord.ucsd.edu/~sgille/mae127/ps1.html`

Plot the air temperature and sea surface temperature data. Be sure to read the data descriptions on the web site, and take account of missing data.

Here's a set of command lines to load and plot the data.

```
load buoy.mat
air_temp(find(air_temp>900))=NaN;
water_temp(find(water_temp>900))=NaN;
plot(datenum(year,month,day,hour,0,0),[air_temp water_temp])
datetick; xlabel('time (years)'); ylabel('temperature')
legend('air temperature','water temperature')
title('buoy measurements: Santa Monica Basin')
print -depsc buoy_timeseries.eps
```

And the resulting plot is in Figure 1.

3. Now write a program in Matlab to compute the mean and variance of the data that you plotted in problem 2. Your program should use a for loop. Verify that your program gives the same results as the Matlab functions ('mean' and 'var' or 'nanmean' and 'nanvar'). Your homework should include a printout of your program as well as a summary of your results.

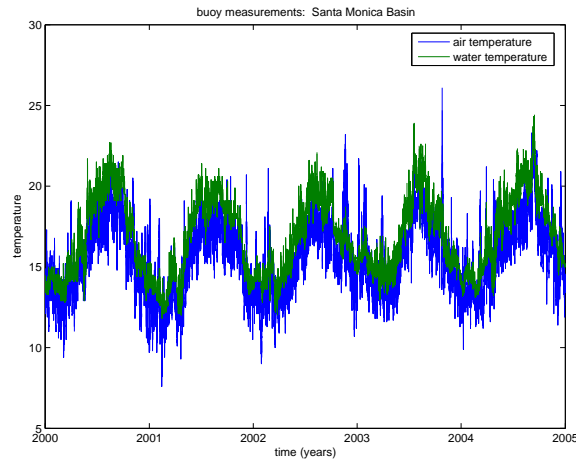


Figure 1: Buoy time series for problem 2.

Here's code to compute the quantities. Here, I've noted that $\overline{(T - \bar{T})^2} = \overline{T^2} - 2\bar{T}\bar{T} + \bar{T}^2 = \overline{T^2} - \bar{T}^2$.

```
% step 1: set all variables to zero.
mean_air=0; mean_water=0; count_air=0; count_water=0;
sqrd_air=0; sqrd_water=0;

%step 2: loop through all temperature measurements
%         accumulate squared temperature
%         since variance is <(T-<T>)^2>=<T^2>-<T>^2
for i=1:length(air_temp)
    if(~isnan(air_temp(i)))
        mean_air=mean_air+air_temp(i);
        count_air=count_air+1;
        sqrd_air=sqrd_air+air_temp(i)^2;
    end
    if(~isnan(water_temp(i)))
        mean_water=mean_water+water_temp(i);
        count_water=count_water+1;
        sqrd_water=sqrd_water+water_temp(i)^2;
    end
end

% step 3: compute mean (by dividing by N) and variance
mean_air=mean_air/count_air;
mean_water=mean_water/count_water;
var_air=((sqrd_air - mean_air^2*count_air)/(count_air-1));
var_water=((sqrd_water - mean_water^2*count_water)/(count_water-1));
```

```
% step 4: compare results:
[mean_air nanmean(air_temp) mean_water nanmean(water_temp)]
[var_air nanvar(air_temp) var_water nanvar(water_temp)]
```

Results show that the mean air temperature is 15.5231°C with a variance of 4.8274°C^2 and for water temperature the mean is 16.7704°C with a variance of 5.7966°C^2 .

4. Write a program in Matlab to compute the median of the data. You may use the Matlab 'sort' function, but do not use the 'median' function. Verify that your result is the same as the result obtained from the Matlab 'median' function. Again turn in a printout of your program as well as a summary of your results.

Here's code:

```
% sort nonmissing temperature data
sorted_air=sort(air_temp(find(~isnan(air_temp))));
sorted_water=sort(water_temp(find(~isnan(water_temp))));

% compute median as midpoint of sorted record; compare with median function
median_air=sorted_air(round(length(sorted_air)/2));
median_water=sorted_water(round(length(sorted_water)/2));

%output and compare with median function
[median_air median(air_temp(find(~isnan(air_temp))));
median_water median(water_temp(find(~isnan(water_temp)))]
```

Results show that the median air temperature is 15.5°C and the median water temperature is 16.6°C .