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MATLAB - Lectures 1^{ST} SEMESTER

LAB 1 IMPORTING AND EXPORTING DATA

Topics Covered:

1. The **load** command.
2. The **save** command.
3. The **`xlsread`** command.
4. The **`xlwrite`** `command`.

This is useful to know how to use **save** and **load** to transfer variables between the Workspace and a disk file.

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IMPORTANCE DATA IN A MODEL

- What is a **model** ?
- The Atmospheric Science community includes a large and energetic group of researchers who devise and carry out measurements in the Atmosphere. This work involves instrument development, algorithm development, **data** collection, **data** reduction, and **data** analysis.
- The **data** by themselves are just numbers. In order to make physical sense of the **data**, some sort of **model** is needed. This might be a qualitative conceptual **model**, or it might be an analytical theory, or it might take the form of a **computer program**.

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IMPORTING AND EXPORTING DATA INPUT/OUTPUT (I/O) DATA

- **Importing data** is the process of retrieving(Input) data from sources external an ASCII text file.
- **Exporting data** is the process of extracting(Output) data from an instance of output data into some user-specified format .
- **load** and **save** are used to **import** and **export** data.

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Other import/export functions

- with differing degrees of flexibility and ease of use, include **csvread**, **csvwrite**, **dlmread**, **dlmwrite**, **fgets**, **fprintf** (which has an optional argument to specify a file), **fscanf**, **textread**, **xlsread** , **xlswrite** You know where to look for the details!
- '-mat' Keyword that indicates that the specified file is a MAT-file.
- '-ascii' Keyword that indicates that the specified file is an ASCII file.

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1. The save command :-

If you want to store the data into an ASCII dat-file (in the **current directory**), make the filename the same as the name of the data and type '*/ascii*' at the end of the *save* statement.

Syntax

save (filename)

Save all workspace variables to (…-.mat)

save(filename, variables)

stores only the specified variables

save (filename, … ,format)

saves in the specified format'-mat' or '-ascii'

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Ex:- Save data to an ASCII file ,and view the contents of the file with the type function.

```
>> p = rand(1, 10);
>> q = ones(10);
>> save('pqfile.txt','p','q','-ascii')
>> save('pqfile.mat','p','q','-mat')
or
>> save pqfile.txt p q -ascii
>> save pqfile.mat p q –mat
```

- The extension -.mat is the default—you can specify a different extension.

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2. The load command :-

The **load** command is the reverse of save. It is used to Importing text (ASCII) data or load data from MAT-file into workspace .

Syntax

S=load (filename)

S=load (filename, variables)

S=load (filename, format ,variables) load in the specified format'-mat' or '-ascii'

load (filename,___) loads without combining MAT-file variables into a structure array .

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```
>> p = rand(1, 10);
>> q = ones(10);
>> save pqfile p q
>> clear all
>> p
Undefined function or variable 'p'.
>> load pqfile p q
>> p
>> q
```

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EXAMPLE 1: THE PRECIPITATION

This example show you how to load a simple data set and plot it.

The PDXprecip.dat file contains two columns of numbers. The first is the number of the month, and the second is the mean precipitation recorded at the Portland International Airport between 1961 and 1990. Here are the MATLAB commands to create a symbol plot with the data from PDXprecip.dat.

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EXAMPLE 1: THE PRECIPITATION

PDXprecip.dat

1	5.35
2	3.68
3	3.54
4	2.39
5	2.06
6	1.48
7	0.63
8	1.09
9	1.75
10	2.66
11	5.34
12	6.13

✓ Documents → MATLAB → R.Click :New → Text Document write the table above and save it as PDXprecip.dat

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script-file precipPlot.m :

```
% Filename: precipPlot.m
% Load data from PDXprecip.dat and plot it with symbols
% read data into PDXprecip matrix
load PDXprecip.dat;
% copy first column of PDXprecip into month and second
%column into precip
month = PDXprecip(:,1);
precip = PDXprecip(:,2);
plot(month , precip,'o');      % plot precip vs. month with circles
xlabel('month of the year');  % add axis labels and plot title
ylabel('mean precipitation (inches)');
title('Mean monthly precipitation at Portland International Airport');
```

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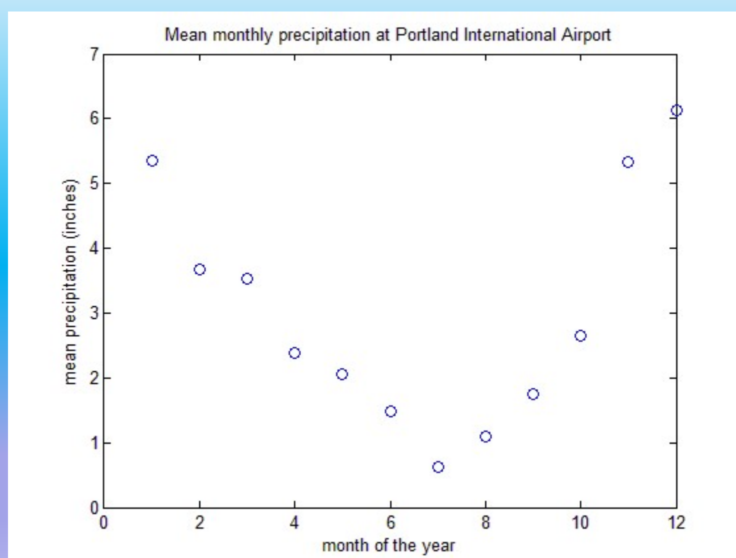

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3. The xlsread command :- Read Microsoft Excel spreadsheet file (.xlsx) ,retrieving or Importing data .

Syntax

num = **xlsread**(filename)

num = **xlsread**(filename , sheet)

num = **xlsread**(filename , xlRange)

num = **xlsread**(filename , sheet , xlRange)

num = **xlsread**(filename , sheet, xlRange ,'basic')

[num , txt , raw] = **xlsread**(___)

___ = **xlsread**(filename,-1)

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num= **xlsread**(filename)

- Read and returns numeric data in double array num from the first sheet in the Microsoft Excel spreadsheet file named filename.

num= **xlsread**(filename,-1)

- Opens the file filename in an Excel window, enabling you to interactively select the worksheet to be read and the range of data on that worksheet to import.

num= **xlsread**(filename, sheet)

- Reads the specified worksheet, where sheet is either a positive, double scalar value or a quoted string containing the sheet name.

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num= **xlsread**(filename, xlRange)

- Reads data from a specific rectangular region of the default worksheet (Sheet1). Specify range using the syntax 'C1:C2', where C1 and C2 are two opposing corners that define the region to be read.

num=**xlsread**(filename , sheet, xlRange)

- Reads data from a specific rectangular region (range) of the worksheet specified by sheet.

num= **xlsread**(filename, sheet , xlRange, 'basic')

- Imports data from the spreadsheet in basic import mode. This is the mode used on UNIX platforms as well as on Windows when Excel is not available as a COM server.

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[num,text,raw]= **xlsread**(filename, …)

- Returns numeric and text data in num and txt, and unprocessed cell content in cell array raw, which contains both numeric and text data.

Example :- Read Data from First Worksheet into Numeric Array .

- Create an Excel file named myExample.xlsx

```
>> values = {1, 2, 3 ; 4, 5, 'x' ; 7, 8, 9};
% to define a subset of the array. Enclose indices in curly brackets, { }, to refer to the text, numbers, or other data within individual cells.
>> headers = {'First','Second','Third'};
>> xlswrite('myExample.xlsx',[headers; values]);
```

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- Read data from the first worksheet

```
>> filename = 'myExample.xlsx';
>> A = xlsread(filename)
or
>> A = xlsread('myExample.xlsx')
A =
    1    2    3
    4    5  NaN
    7    8    9
>> [num text raw]=xlsread('myExample.xlsx')
```

❖ xlsread returns the numeric data in array A .

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```
>> [num text raw]=xlsread('myExample.xlsx')
num =
    1    2    3
    4    5  NaN
    7    8    9
text =
   'First'   'Second'   'Third'
   ''        ''         ''
   ''        ''         'x'
raw =
   'First'   'Second'   'Third'
   [    1]   [     2]   [    3]
   [    4]   [     5]     'x'
   [    7]   [     8]   [    9]
```

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EXAMPLE 2: READ A SPECIFIC RANGE OF DATA FROM THE EXCEL FILE IN THE PREVIOUS EXAMPLE.

```
>> filename = 'myExample.xlsx';
>> sheet = 1;
>> xlRange = 'B2:C3';
>> subsetA = xlsread(filename, sheet, xlRange)
subsetA =
        2       3
        5       NaN
```

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EXAMPLE 3: Import data of the outdoor temperature, Sunlight radiation, pressure and the relative humidity from nivada.xlsx
Do four plots of outdoor temperature, sunlight radiation, pressure, and relative humidity versus time (hours) for Nivada dataset 2007 for four months (Jan. to Apr.)

M1

	A	B	C	D	E	F	G	H	I	J	K	L
1	Year	Day of Year	Month	Day	Hour	Solar Altitude	Solar Energy(W/m^2)	Air Temp(C°)	Wind Speed(m/s)	Wind Dir	Pressure(hpa)	RH %
2	2007	1	1	1	0	-73	0	-6.9	0.9	193	907	72
3	2007	1	1	1	1	-64	0	-7	1	147	907	73
4	2007	1	1	1	2	-52	0	-8.4	0.9	188	908	77
5	2007	1	1	1	3	-40	0	-7.8	1	194	908	78
6	2007	1	1	1	4	-29	0	-9.4	0.9	174	908	81
7	2007	1	1	1	5	-17	0	-8.9	1.1	193	909	82
8	2007	1	1	1	6	-6	1	-7.5	1.3	180	909	78
9	2007	1	1	1	7	5	58	-6.5	1	162	910	78
10	2007	1	1	1	8	14	228	2.5	1.8	336	910	51
11	2007	1	1	1	9	22	373	7.7	2.3	55	910	38
12	2007	1	1	1	10	27	476	10.4	4.3	40	910	32
13	2007	1	1	1	11	30	524	11.8	6.2	30	909	29
14	2007	1	1	1	12	29	511	12.5	6.2	49	908	28
15	2007	1	1	1	13	25	439	12.9	5.8	10	908	27
16	2007	1	1	1	14	19	317	12.9	5.5	342	908	27
17	2007	1	1	1	15	10	163	12	5	288	908	28
18	2007	1	1	1	16	0	21	9.3	3.7	34	908	33
19	2007	1	1	1	17	-10	0	5.9	1.6	110	909	39
20	2007	1	1	1	18	-22	0	6	2.8	30	910	41
21	2007	1	1	1	19	-34	0	3.8	1.1	166	911	45
22	2007	1	1	1	20	-46	0	4.3	3.1	21	911	46
23	2007	1	1	1	21	-57	0	4.8	2.5	24	912	44
24	2007	1	1	1	22	-68	0	5.1	3.3	30	912	43
25	2007	1	1	1	23	-75	0	3.7	3.2	33	912	48

Data Sheet2 Sheet3

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script-file myNivada.m :

```
% Filename: myNivada.m
% by Thaer O. Roomi (2014)
% This program plots the values of temperature, sunlight radiation,
% Average pressure, and Relative Humidity for hourly averages
% versus the time (hours) for four months (1,2,3 and 4) 2007.
clear all
[num txt]=xlsread('nivada.xlsx');
year=num(:,1) ; day_of_year=num(:,2) ; hour=num(:,5);
DateNumber = datenum(year,month,day,hour,0,0);
temperature=num(:,8);
sunlight=num(:,7);
pressure=num(:,11);
relhum=num(:,12);
```

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```
% divided figure into 4-plots
subplot(2,2,1)
plot(DateNumber, temperature)
xlabel('Time [hours]')
ylabel('Temperature [degrees C]')
title('Outdoor temperature in Nivada 2007')
%datetick('x','mmm','keepticks')
%datetick('x','mmm-dd (ddd)','keepticks')
%datetick('x','HHPM','keepticks')
datetick('x','yyyy-mmm','keepticks')
```

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```
subplot(2,2,2)
 plot(DateNumber,sunlight)
 xlabel('Time [hours]')
 ylabel('Sunlight radiation [W/m^2]')
 title('Sunlight radiation in Nivada 2007')
datetick('x','yyyy-mmm','keepticks')
subplot(2,2,3)
 plot(DateNumber,pressure)
xlabel('Time [hours]')
 ylabel('Pressure [hPa]')
 title('Average station pressure in Nivada 2007')
datetick('x','yyyy-mmm','keepticks')
```

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```
grid on
 subplot(2,2,4)
 plot(DateNumber,relhum)
xlabel('Time [hours]')
 ylabel('Relative Humidity [%]')
 title('Relative Humidity in Nivada')
datetick('x','yyyy-mmm','keepticks')
```

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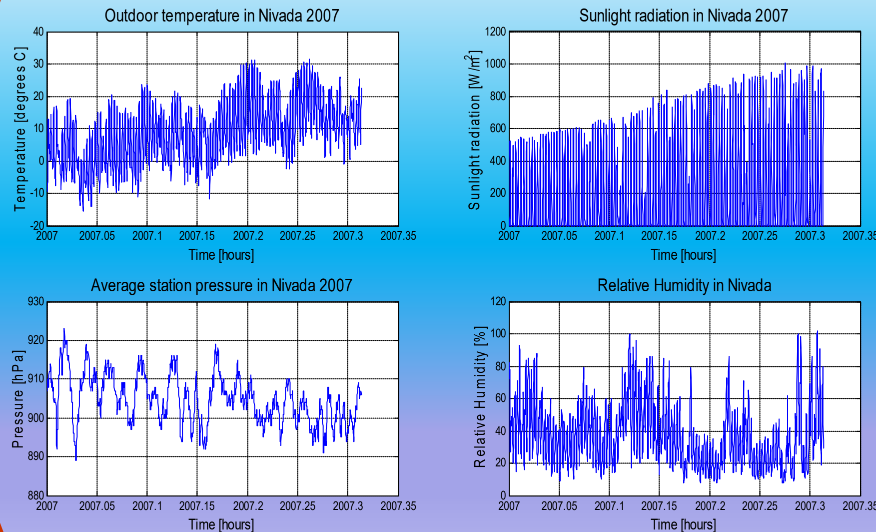

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IMPORTING AND EXPORTING DATA

4. The xlswrite command :- Write Microsoft Excel spreadsheet file (.xlsx) , extracting or Exporting data .

Syntax

xlswrite(filename ,A)

xlswrite(filename ,A, sheet)

xlswrite(filename ,A, xlRange)

xlswrite(filename ,A, sheet , xlRange)

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IMPORTING AND EXPORTING DATA

xlswrite(filename ,A)

- Writes array A to the first worksheet in Excel file, filename , starting at cell A1.

xlswrite(filename ,A, sheet)

- Writes to the specified worksheet.

xlswrite(filename ,A, xlRange)

- Writes to the rectangular region specified by xlRange in the first worksheet of the file.

xlswrite(filename ,A, sheet, xlRange)

- Writes to the specified sheet and range, xlRange.

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Example :- Write Data to a Spreadsheet First. Write a 7-element vector to an Excel file, testdata.xlsx.

```
>> filename = 'testdata.xlsx';
>> A = [12.7, 5.02, -98, 63.9, 0, -.2, 56];
>> xlswrite(filename , A)
```

Example :- Write Data to a Specific Sheet and Range in a Spreadsheet. Write mixed text and numeric data to an Excel file, testdata.xlsx, Starting at cell E1 of Sheet2.

```
>> filename = 'testdata.xlsx';
>> A = {'Time', 'Temperature'; 12,98; 13,99; 14,97};
>> sheet = 2;
>> xlRange = 'E1';
>> xlswrite(filename, A, sheet , xlRange)
```

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Homework

Write a MATLAB program to read the numerical and analytical solutions in table (1) from excel sheet file to calculate the mean of the numerical values, “Qurter,Hourly,Simidiurnal,Diurnal”

Note: use an Excel spreadsheet to reading and writing values. Then draw each of numerical values versus the time steps.

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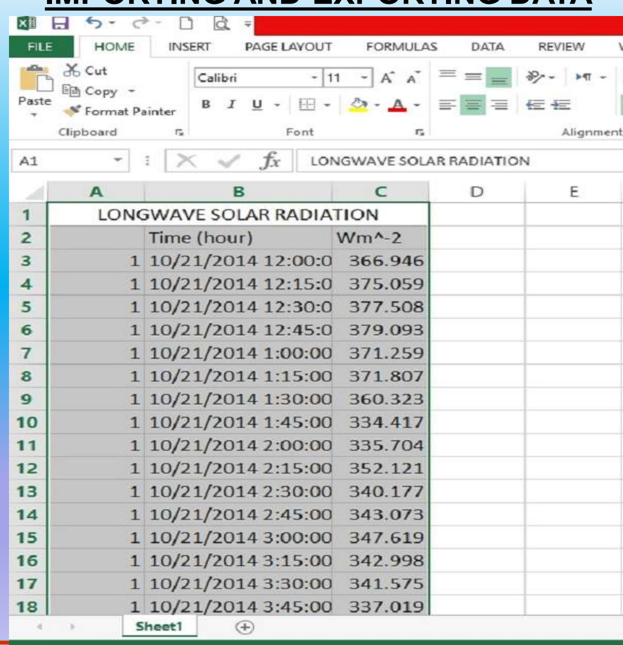

	A	B	C
1	LONGWAVE SOLAR RADIATION		
2		Time (hour)	Wm^-2
3	1	10/21/2014 12:00:0	366.946
4	1	10/21/2014 12:15:0	375.059
5	1	10/21/2014 12:30:0	377.508
6	1	10/21/2014 12:45:0	379.093
7	1	10/21/2014 1:00:00	371.259
8	1	10/21/2014 1:15:00	371.807
9	1	10/21/2014 1:30:00	360.323
10	1	10/21/2014 1:45:00	334.417
11	1	10/21/2014 2:00:00	335.704
12	1	10/21/2014 2:15:00	352.121
13	1	10/21/2014 2:30:00	340.177
14	1	10/21/2014 2:45:00	343.073
15	1	10/21/2014 3:00:00	347.619
16	1	10/21/2014 3:15:00	342.998
17	1	10/21/2014 3:30:00	341.575
18	1	10/21/2014 3:45:00	337.019

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```
clear all , clc
[A date]=xlsread('long_w.xlsx');
C=A(:,3);                    % Read data
h=0;                         % new index for the new values
n=numel(C);                  % number of elements in the excel
sheet
for i=1:4:n-3                % read i =1,5,9,…n-3
   h=h+1; % to add 1 to index h=1,2,3,4,…
   C_mean_4(h)=mean(C([i:i+3]));  % find mean value for
each 4 elements of the array
end
if mod(n,4)~=0;
C_mean_4(h+1)= mean(C(n-mod(n,4):end));
end
```

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```
clear all , clc
[A date]=xlsread('long_w.xlsx');
C=A(:,3);               % Read data
h=0;                    % new index for the new values
n=numel(C);             % number of elements in the excel
sheet
Time=date(3:end,2);
formatIn={'mm/dd/yyyy HH:MM:SS AM'}
%dt = datestr(now,'mmmm dd, yyyy HH:MM:SS.FFF AM')
dt=datenum(Time,formatIn);
yy=year(dt);mm=month(dt);dd=day(dt);hr=hour(dt);mint=mi
nute(dt);
```

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```
%%%%%%%Hourly Mean %%%%%%%%%%%
h=0;
for i=1:n-1
   if hr(i)==hr(i+1)
      continue
   else
      h=h+1;
index=find(hr==hr(i)&dd==dd(i)&mm==mm(i)&yy==yy(i));
C_4(h)=nanmean(C(index)); datevector_hourly(h,:)=[yy(i)
mm(i) dd(i) hr(i) 0 0];
end
end
```

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```
index=find(hr==hr(n)&dd==dd(n)&mm==mm(n)&yy==yy(
n))
   C_4(h+1)=nanmean(C(index));
datevector_hourly(h+1,:)=[yy(n) mm(n) dd(n) hr(n) 0 0];
```

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```
%%%%%%%% Daily Mean %%%%%%%%%%
   h=0;
   for i=1:n-1
   if dd(i)==dd(i+1)
      continue
   else
      h=h+1;
      index=find(dd==dd(i)&mm==mm(i)&yy==yy(i));
      C_24(h)=nanmean(C(index));
datevector_daily(h,:)=[yy(i) mm(i) dd(i) 0 0 0];
end
   end
```

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```
index=find(dd==dd(n)&mm==mm(n)&yy==yy(n))
   C_24(h+1)=nanmean(C(index));
datevector_daily(h+1,:)=[yy(n) mm(n) dd(n) 0 0 0];
filename='long_w.xlsx';
sheet = 2;
label={'year','month','day','hour','Hourly-DATA'};
xlswrite(filename,label,sheet,'A1')
xlswrite(filename,datevector_hourly,sheet,'A2')
xlswrite(filename,C_4',sheet,'E2')
```

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```
sheet=3;
label2={'year','month','day','Daily-DATA'};
xlswrite(filename,label2,sheet,'A1')
xlswrite(filename,datevector_daily,sheet,'A2')
xlswrite(filename,C_24',sheet,'D2')

%%%% PLOT
d=datenum(Time);
d1=datenum(datevector_hourly);
d2=datenum(datevector_daily);
% datenum :Convert date and time to serial date number
```

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```
figure(1)
hold on
plot(d,C,'.:B')
plot(d1,C_4','.:G')
plot(d2,C_24','R')
datetick('x','mmm-DD','keepticks')
xlabel('Time(hr)')
ylabel('LongWave Solar Radiation (W/m^2)')
title('Long Wave Solar Radiation')
legend('QURTER','HOURLY','DAILY')
```

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Homework2

Write a MATLAB program to read data for Aerosol Optical Depth from Excel spreadsheet file AOD.xlsx to calculate the mean of monthly, seasonal and yearly .

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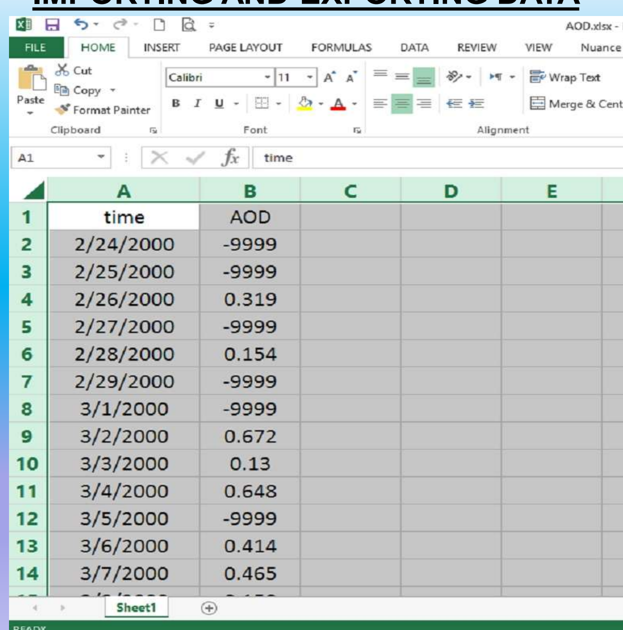

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```
% This is a program to calculate mean of monthly, seasonal
and yearly data.
clear all,clc
[num txt]=xlsread('AOD.xlsx');
date=txt(2:end,1);
formatIn = 'mm/dd/yyyy';
t=datenum(date,formatIn);
c1=find(num==-9999);
t(c1)=[];num(c1)=[];
y=year(t);m=month(t);d=day(t);
AOD=num;
%%%%%% MEAN OF MONTHLY DATA %%%%%%
 h=0;
```

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```
for yy=2000:2016
  h=h+1;
  for mo=1:12
  in=find(y==yy);
  in1=find(m(in)==mo);
  monthly(h,mo)=mean(AOD(in1));
   end
 end
 filename='AOD.xlsx'; sheet=2;
dd={'Jan','Feb','Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','Dec'};
xlswrite(filename,dd,sheet,'b1')
xlswrite(filename,{'YEAR'},sheet,'A1')
xlswrite(filename,[2000:2016]',sheet,'a2')
xlswrite(filename,monthly,sheet,'B2')
```

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```
%%%%%% MEAN OF SEASONAL DATA %%%%%%
a=monthly;
c=isnan(a);
  c1=find(c==1);
  a(c1)=0;
winter=mean(a(:,[12,1,2])');
winter=winter';
spring=mean(a(:,[3,4,5])');
spring=spring';
summer=mean(a(:,[6,7,8])');
summer=summer';
autumn=mean(a(:,[9,10,11])');
autumn=autumn';
```

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```
sheet=3;
ddd={'YEAR','Winter','Spring','Summer','Autumn'};
aa=[winter,spring,summer,autumn];
xlswrite(filename,ddd,sheet,'A1')
xlswrite(filename,[2000:2016]',sheet,'a2')
xlswrite(filename,aa,sheet,'b2')
%%%%%% MEAN OF SEASONAL DATA %%%%%%
h=0;
for yy=2000:2016
    h=h+1;
   in=find(y==yy);
   yearly_mean(h)=mean(AOD(in));
end
```

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```
sheet=4;
xlswrite(filename,{'YEAR'},sheet,'A1')
xlswrite(filename,[2000:2016]',sheet,'a2')
xlswrite(filename,{'AOD'},sheet,'B1')
xlswrite(filename,yearly_mean',sheet,'B2')
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

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	A	B	C	D	E	F	G	H	I	J	K	L	M
1	YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	2000		0.2365	0.41529	1.1095	0.70592	0.86427	0.99585	0.77067	0.50511	0.33484	0.26739	0.26907
3	2001	0.40765	1.0085	0.91729	0.48491	1.01153	0.4428	0.54707	0.34013	0.2706	0.30467	0.28173	0.39619
4	2002	0.39647	0.99737	0.68375	0.91554	1.01306	0.51392	0.49936	0.36058	0.25871	0.27074	0.28765	0.44325
5	2003	0.42777	1.15969	0.68007	0.865	0.99316	0.46448	0.34255	0.28288	0.29204	0.33648	0.35253	0.53643
6	2004	0.40765	0.97738	0.82175	0.83356	0.9461	0.519	0.3525	0.2564	0.27648	0.32864	0.34144	0.37738
7	2005	0.3725	1.01787	0.73636	0.85738	1.0348	0.56674	0.394	0.35712	0.2686	0.29026	0.3222	0.33795
8	2006	0.32492	0.56709	1.08973	0.68375	0.831	1.09233	0.47874	0.39505	0.28027	0.28816	0.3182	0.344
9	2007	0.40657	1.25045	0.66406	0.949	1.02644	0.55094	0.40806	0.37587	0.25227	0.28735	0.28124	0.37541
10	2008	0.34387	0.99489	0.68365	0.87793	0.99221	0.45882	0.44323	0.38713	0.26276	0.27729	0.31858	0.345
11	2009	0.39939	1.05847	0.74861	0.79443	1.00933	0.46164	0.41017	0.38406	0.25955	0.27074	0.34433	0.33471
12	2010	0.40765	0.8261	1.1015	0.95906	0.78328	0.7512	0.52171	0.34976	0.25437	0.27595	0.32687	0.34113
13	2011	0.39939	1.05847	0.6568	0.94536	0.9353	0.51957	0.391	0.3549	0.2686	0.30904	0.3001	0.35084
14	2012	0.39647	1.13538	0.68861	1.05	0.84507	0.48506	0.3942	0.31889	0.29973	0.29805	0.31671	0.33244
15	2013	0.32492	0.87428	0.80146	0.88556	0.92075	0.62945	0.394	0.32519	0.29973	0.27165	0.39619	0.2998
16	2014	0.39939	0.94839	0.77754	1.04413	0.48506	0.40776	0.30188	0.28894	0.26082	0.33605	0.34014	0.50376
17	2015	0.39939	1.01178	0.91632	0.79831	0.88525	0.5107	0.53	0.2964	0.32519	0.30778	0.29	0.31122
18	2016	0.46296	1.12427										
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Sheet1 Sheet2 Sheet3 Sheet4

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1ST

IMPORTING AND EXPORTING DATA

	A	B	C	D	E
1	YEAR	Winter	Spring	Summer	Autumn
2	2000	0.16852	0.74357	0.87693	0.36911
3	2001	0.60411	0.80457	0.44333	0.28566
4	2002	0.61236	0.87078	0.45796	0.27237
5	2003	0.70796	0.84607	0.3633	0.32702
6	2004	0.58747	0.86713	0.37597	0.31552
7	2005	0.57611	0.87618	0.43928	0.29369
8	2006	0.412	0.86816	0.65537	0.29554
9	2007	0.67748	0.87983	0.44495	0.27362
10	2008	0.56125	0.85126	0.42973	0.28621
11	2009	0.59752	0.85079	0.41862	0.29154
12	2010	0.52496	0.94795	0.54089	0.28573
13	2011	0.6029	0.84582	0.42182	0.29258
14	2012	0.62143	0.86123	0.39938	0.30483
15	2013	0.49966	0.86926	0.44955	0.32252
16	2014	0.61718	0.76891	0.33286	0.31234
17	2015	0.57413	0.86662	0.4457	0.30766
18	2016	0.52908	0	0	0
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Sheet1 Sheet2 **Sheet3** Sheet4

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1ST

IMPORTING AND EXPORTING DATA

	A	B	C	D
1	YEAR	AOD		
2	2000	0.57768		
3	2001	0.39505		
4	2002	0.41225		
5	2003	0.48392		
6	2004	0.41922		
7	2005	0.57921		
8	2006	0.45174		
9	2007	0.48676		
10	2008	0.625		
11	2009	0.666		
12	2010	0.5359		
13	2011	0.57806		
14	2012	0.66496		
15	2013	0.52937		
16	2014	0.43436		
17	2015	0.46795		
18	2016	0.27859		

Sheet1 Sheet2 Sheet3 **Sheet4**

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