Exercises for Programming with Matlab

Obtaining the Examples

1. The course examples are available under the CIC6007 course on the online learning system, see matlab examples under the course content

The matlab examples zip file can also be downloaded from

http://rcg.group.shef.ac.uk/courses/cic6007 /matlab_examples.zip

Iceberg users may extract the examples from a tgz archive in the directory /usr/local/courses on iceberg.

On ShARC, use cd to change directory to a working directory of your choice then use the cp and tar commands to obtain and extract the examples.

The required commands are

cd ~/myworkingdirectory

tar –zxvf /usr/local/courses/matlab_examples.tgz

Practice Session 1

Getting Started

- Startup MATLAB
- Start up and experiment with the following

– Editor

– Demos

– Help

– Use the file/files File operations to navigate directories

– Under the applications menu start up the variable browser (windows only).

Practice on the command window

- Enter the following lines into the command window and observe what happens:

```
a = 1.234
b= 5.6
```

```
c = a*b
D = [ a b c ]
E = [ c ; b; a]
F = D*E
G= E*del2
```

- Use the who and whos command to get information about the assigned variables note how the variables are stored and how much storage is used.

Exercises 1: Matrices

1.1 Define the following matrix in MATLAB:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 2 & 6 & 6 \end{bmatrix}$$

1.2 Define a row vector X which is set to the second row of matrix A

1.3 Define a column vector Y, which is set to the first column of A

1.4 Define a column vector Z, which is set to the first row of A

1.5 Define a column vector V, which contains the third column of A in reverse order

1.6 Find out X*Y and Y*X

```
A = [ 1 2 3 ; 3 4 5 ; 2 6 6 ] ;
X = A( 2, : )  ;
Y =  A( : , 1 )  ;
Z = A(1, : )';
V = A(3:-1:1 , 3)  ;
W1= Y*Z ;
W2 = Z*Y  ;
```

1.7 Find the determinant of A

Determine the solution of the following simultaneous equations

x + 2y + 3z = 4

3x+ 4y + 5z = 14

2x+ 6y + 6z = 20

```
% w = [%RHS here]
% A=[] %define matrixe of coefficients
% xyz=..... % compute solution using inverse of A

D = det(A)  ;
w = [4;14;20]  ;

xyz = inv(A)*w;
%or
% xyz = A\w
```

Exercises 2 : Functions Applied to Arrays and Matrices

2.1 Using the RAND function define a 16 by 16 matrix R of random numbers, elements of which range between 0 and 10.

2.2 Using the PASCAL function set B to the 5 by 5 Pascal triangle

2.3 Find the inverse of matrix B and store it in C

2.4 Using the SUM function find the sum of each column of matrix C

2.5 Define a new matrix D which is the subset of B and made up of rows 2 to 4 and columns 2 to 4 of the B matrix.

```
R= 10*rand (16 , 16 ) ;
B = pascal ( 5 ) ;
C = inv(B) ;
Sum(C) ;
D= C(2:4,2:4) ;
```

Exercises 3: Data Types

Store the following table -

(a) As a cell array

(b) As a structure

Alkali metal	Standard atomic weight (u)	Density ($g \cdot cm^{-3}$)	Colour Index
Lithium	6.941	0.534	[0.3 0.4 0.3]
Sodium	22.990	0.968	[0.6 0.8 0.7]
Potassium	39.098	0.89	[0.2 0.3 0.2]

```
%alkali metals as a cell array
alkalimetals=cell(3,4);

%alkali metals as a structure
% s = struct(field1,value1,...,fieldN,valueN)
am(1)=struct('name','Lithium','aw',6.941,'density',0.534,'cindex',[0.3 0.4 0.3]);
am(2)=struct('name','Sodium','aw',22.990,'density',0.968,'cindex',[0.6 0.8 0.7]);
```

Exercise 4 : Writing MATLAB Functions

Sin(x) can be represented by the series;

Sin(x) = x – x3/3! + x5/5! – x7/7! + …

- Write a MATLAB function named mysine that will calculate sin(x) to the power 11.
- Improve your function by putting checks for the range of x and n supplied by the user.
- Modify the function so that the calculations are carried out to any user specified number of terms *(n).*

```
%you may write the following in a separate function file called mysine

% % % function y = mysin(x)
% % %     % MYSIN : Calculates the sine of an angle expressed
% % %     %          in radians.
% % %     sum = x ;
% % %     nexterm = x ;
% % %     for i =3:2:11
% % %       nexterm = -nexterm.*x.^2./(i*(i-1));
% % %       sum = sum+nexterm;
% % %     end
% % %     y = sum;
% % % end
```

```
% % % %improved function
% % % function y = mysin(x)
% % % % MYSIN : Calculates the sine of an angle expressed
% % % %          in radians using 5 terms of the expansion.
% % % %         Range must be between +- pi.
```

```
% % % %
% % % if x < pi & x > -pi
% % %   sum = x ;
% % %   nexterm = x ;
% % %   for i =3:2:11
% % %     nexterm = -nexterm.*x.^2./(i*(i-1));
% % %     sum = sum+nexterm;
% % %   end
% % % else
% % %    sum = nan;
% % %
% % %   disp(['Outside the permited range of ' , num2str(-pi),...
% % %         ' to ' , num2str(pi) ] );
% % % end
% % % y = sum;
% % % end
```

```
% % % %compute to any number of terms
% % % function y = mysin(x,nseries)
% % % % MYSIN : Calculates the sine of an angle expressed
% % % %          in radians.
% % % %          Range must be between +- pi.
% % % % Second parameter is optional which determines the number of
% % % % terms in the series. Default is 5.
% % % if exist('nseries','var' )
% % %    nn = nseries*2 + 1;
% % % else
% % %    nn = 11;
% % % end
% % %
% % % if x < pi & x > -pi
% % %   sum = x ;
% % %   nexterm = x ;
% % %   for i =3:2:nn
% % %     nexterm = -nexterm.*x.^2./(i*(i-1));
% % %     sum = sum+nexterm;
% % %   end
% % % else
% % %    sum = nan;
% % %    disp(['Outside the permited range of ' , num2str(-pi),...
% % %         ' to ' , num2str(pi) ] );
% % % end
% % % y = sum;
% % % end
```

Exercise 5: Data Import

Import the data gasprices.csv in the exercise folder into a table.

```
G = readtable('../data/gasprices.csv', 'Delimiter', ',', 'Headerlines', 4);
```

```
Warning: Variable names were modified to make them valid MATLAB identifiers. The original names are
saved in the VariableDescriptions property.
```

Extract the data for Japan, and compute mean and std.

```
JP = G.Japan;
JP_mean = mean(JP);
JP_std = std(JP);
```

Extract the data for Europe, and compute the mean European price in each year.

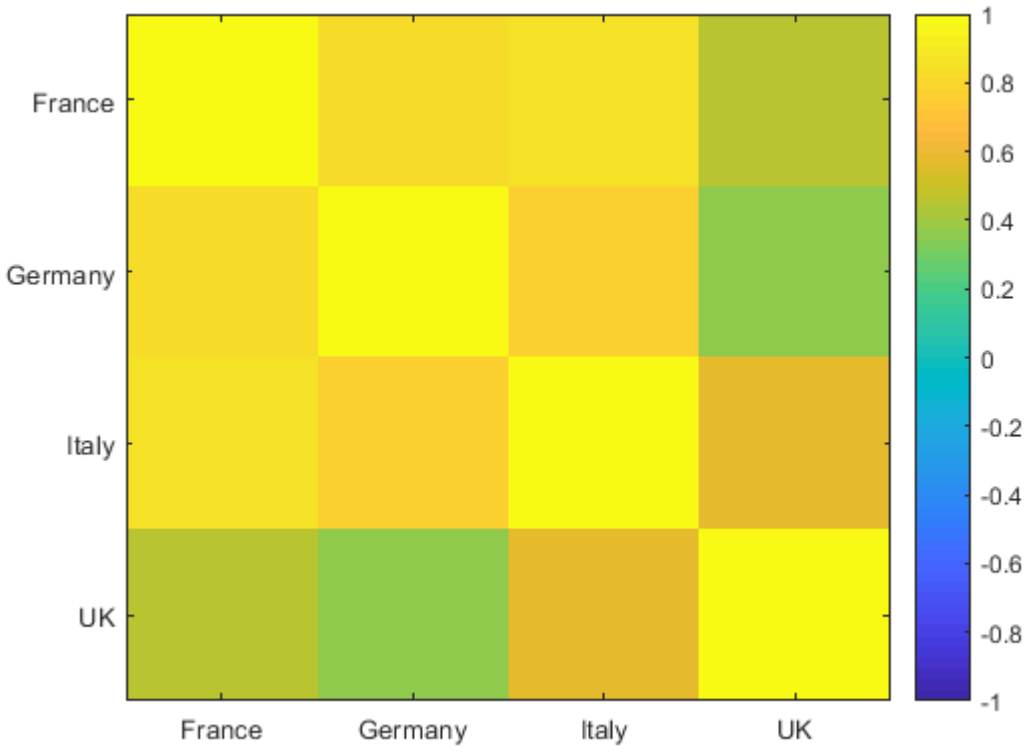
```
Europe = [G.France, G.Germany, G.Italy, G.UK];
annualEuroMeans = mean(Europe, 2);
```

Compute the return series for Europe.

```
Euro_Returns = log( Europe(2:end, :) ./ Europe(1:end-1, :) );
```

Compute and visualise correlation.

```
C = corrcoef(Euro_Returns);
figure
imagesc(C, [-1, 1])
set(gca, 'XTick', 1:4, 'XTickLabel', {'France', 'Germany', 'Italy', 'UK'}, ...
    'YTick', 1:4, 'YTickLabel', {'France', 'Germany', 'Italy', 'UK'})
colorbar
```


France
Germany
Italy
UK
France
Germany
Italy
UK
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1