MATLAB: Manipulating Data

1. Data import and manipulation

2. In-class exercise

MATLAB: Manipulating Data

Data Import and Manipulation

Excel Spreadsheets

- MATLAB offers much more functionality for data analysis than Excel

- Excel spreadsheets can be imported into and exported from MATLAB

- **xlsfinfo** – determine if file contains Excel spreadsheet

- **xlsread** – read Excel spreadsheet file into MATLAB workspace

- **xlswrite** – write Excel spreadsheet file from MATLAB workspace

Excel Spreadsheet Example

```
>> x=xlsread('cstr');
>> x
x =
   0.2500   3.8000 320.0000
   0.5000   5.2000 312.0000
   0.7500   6.3000 308.0000
   1.0000   6.8000 304.0000
   2.0000   7.2000 302.0000
>> size(x)
ans =
    5    3
```

```
>> x(:,1)
ans =
    0.2500
    0.5000
    0.7500
    1.0000
    2.0000
>> x(1,:)
ans =
    0.2500   3.8000 320.0000
>> x(2,2)
ans =
    5.2000
```

MATLAB Folders

- MATLAB files are organized in folders
- **dir** – list folder contents
- **ls** – list folder contents
- **type** – display contents of file
- **what** – list MATLAB files in folder
- **cd** – change current folder
- **delete** – remove files or objects
- **mkdir** – make new folder
- **rmdir** – remove folder
- **addpath** – add folders to search path

MATLAB Workspace

- Variables are stored in the workspace
  - » **who** – list current variables
  - » **whos** – detailed list of variables
  - » **clear** – removes all variables from the workspace
  - » **clear x** – removes variables x from the workspace

- Variable in the workspace can be saved and loaded as .mat files
  - » **save filename** – save all variables in workspace to the filename.mat
  - » **save(filename,x,y,z)** – save variable x, y and z in workspace to the filename.mat
  - » **load filename** – load all variables in filename.mat to the workspace
  - » **load(filename,x,y,z)** – load variables x, y and z in filename.mat to the workspace

UMASS

Data Manipulation Example

```
>> x0 = 0.1;
>> r1 = 0.5;
>> r2 = 1;
>> r3 = 2;
>> t = [0:1:10]
t =
   0   1   2   3   4   5   6   7   8   9   10
>> x1 = 1./(1+(1/x0-1)*exp(-r1*t))
x1 =
 Columns 1 through 7
   0.1000   0.1548   0.2320   0.3324   0.4509   0.5751   0.6906
 Columns 8 through 11
   0.7863   0.8585   0.9091   0.9428
>> x2 = 1./(1+(1/x0-1).*exp(-r2*t));
>> x3 = 1./(1+(1/x0-1).*exp(-r3*t));
```

$$x(t) = \frac{1}{1+\left(\dfrac{1}{x_0}-1\right)e^{-rt}}$$

Data Manipulation Example

>> size(x1)

ans =

  1   11

>> x1'

ans =

  0.1000

  0.1548

  0.2320

  0.3324

  0.4509

  0.5751

  0.6906

  0.7863

  0.8585

  0.9091

  0.9428

>> size(x1')

ans =

  11   1

>> x = [x1' x2' x3']

x =

0.1000	0.1000	0.1000
0.1548	0.2320	0.4509
0.2320	0.4509	0.8585
0.3324	0.6906	0.9782
0.4509	0.8585	0.9970
0.5751	0.9428	0.9996
0.6906	0.9782	0.9999
0.7863	0.9919	1.0000
0.8585	0.9970	1.0000
0.9091	0.9989	1.0000
0.9428	0.9996	1.0000

Data Manipulation Example

>> plot(t,x)
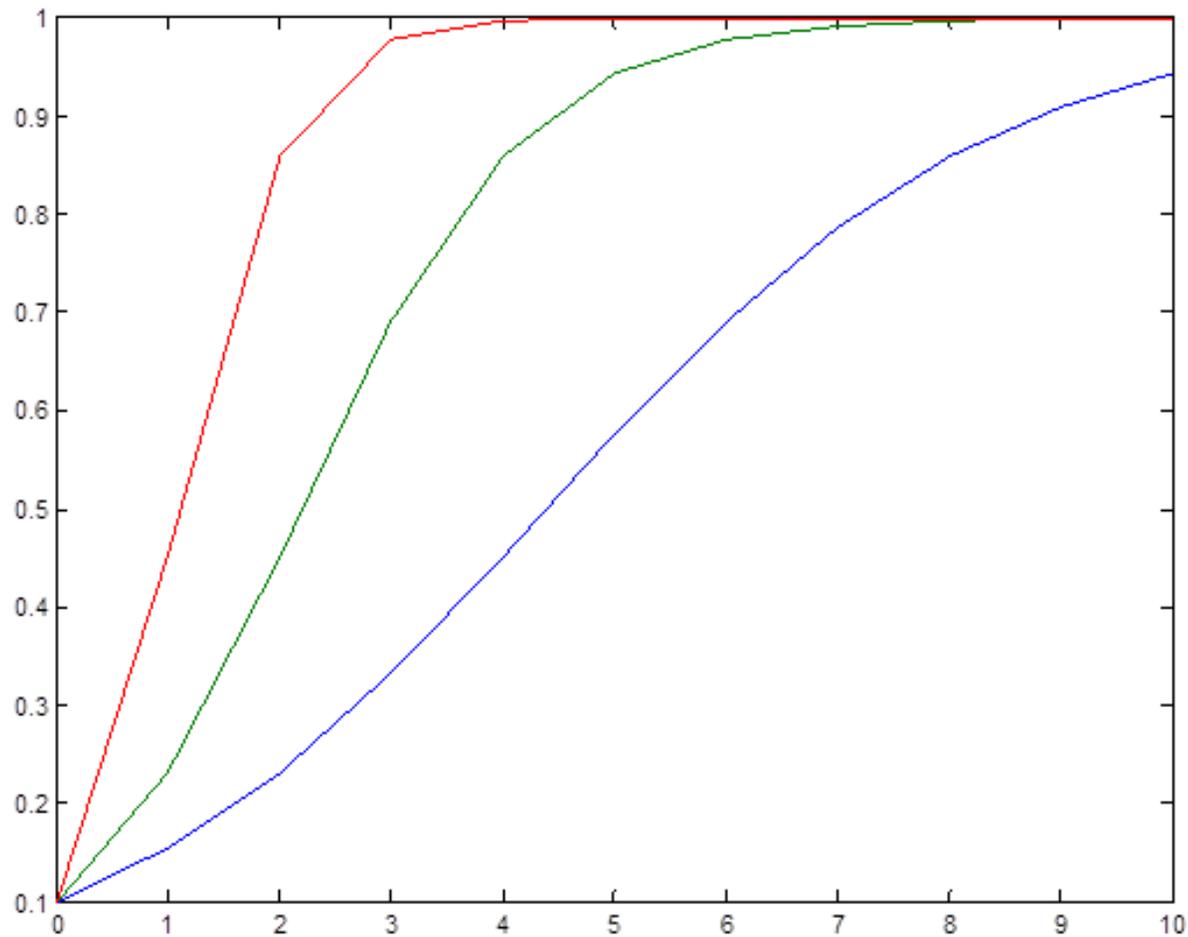
Data Manipulation Example

>> data = [t x]

??? Error using ==> horzcat

CAT arguments dimensions are not consistent.

>> size(t)

ans =

    1   11

>> size(x)

ans =

    11   3

>> data = [t' x]

data =

0	0.1000	0.1000	0.1000
1.0000	0.1548	0.2320	0.4509
2.0000	0.2320	0.4509	0.8585
3.0000	0.3324	0.6906	0.9782
4.0000	0.4509	0.8585	0.9970
5.0000	0.5751	0.9428	0.9996
6.0000	0.6906	0.9782	0.9999
7.0000	0.7863	0.9919	1.0000
8.0000	0.8585	0.9970	1.0000
9.0000	0.9091	0.9989	1.0000
10.0000	0.9428	0.9996	1.0000

>> save('logistic','data')

>> save logistic

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In-class Exercise

Exercise

- Two batch penicillin fermentation experiments were performed

- The data for the two experiments is stored in the file 'penicillin.xls'

  » First column: time for the two experiments

  » Second column: cell concentration for the two experiments

  » Third column: penicillin concentration for the two experiments

- Plot the ratio of the penicillin and cell concentrations versus time for the two experiments

Exercise

Time (hours)	Batch 1		Batch 2	
	Cell concentration (% dry weight)	Penicillin concentration (units/mL)	Cell concentration (% dry weight)	Penicillin concentration (units/mL)
0	0.4	0	0.18	0
10		0	0.12	0
22	0.99	0.0089	0.48	0.0089
34		0.0732	1.46	0.0642
46	1.95	0.1446	1.56	0.2266
58		0.523	1.73	0.4373
70	2.52	0.6854	1.99	0.6943
82		1.2566	2.62	1.2459
94	3.09	1.6118	2.88	1.4315
106		1.8243	3.43	2.0402
118	4.06	2.217	3.37	1.9278
130		2.2758	3.92	2.1848
142	4.48	2.8096	3.96	2.4204
154		2.6846	3.58	2.4615
166	4.25	2.8738	3.58	2.283
178		2.8345	3.34	2.7078
190	4.36	2.8828	3.47	2.6542