TECHNISCHE UNIVERSITÄT DRESDEN

Introduction to Matlab

Data Handling, Random Numbers, Plots

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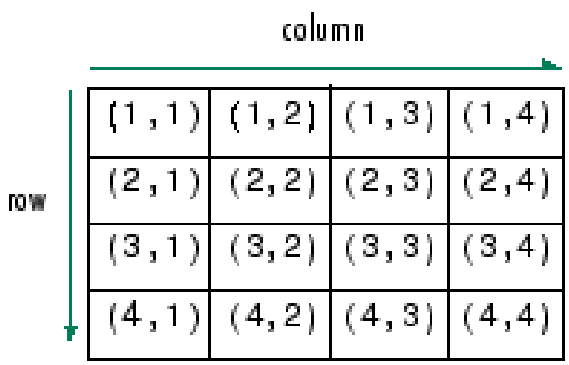
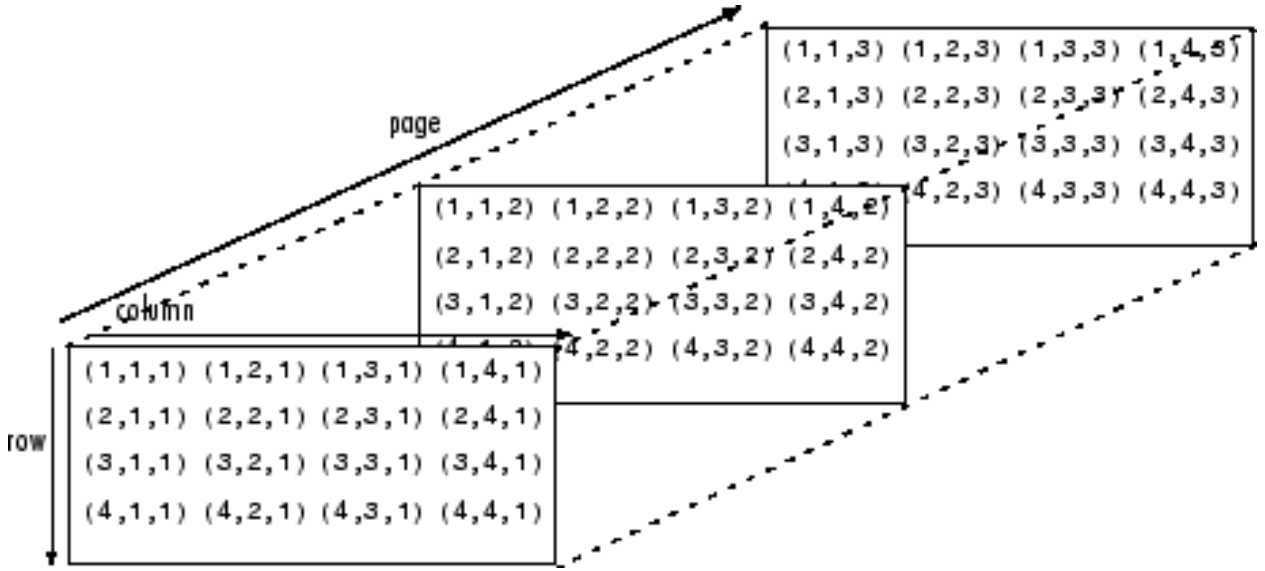
DRESDEN concept
Exzellenz aus Wissenschaft und Kultur

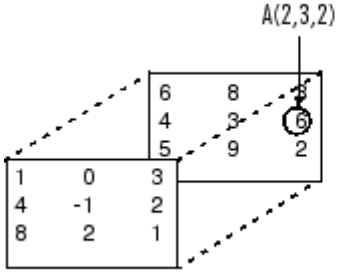
Today's Plan

Date	Topics	Projects
17.04.	Intro, basic operations, matrices	
24.04.	Data handling, random numbers, basic plotting	1st Project Assignment
01.05.	Holiday (Labour day)	
08.05	Advanced plotting, scripts, control flow 1st Project Presentation	1st Project Deadline 2nd Project Assignment
15.05.	Control flow statements, signal processing,	
22.05.	Functions, integration, image, and sound	
29.05.	Holiday (Pfingstferien)	
05.06.	Data Analysis, statistics, 2nd Project Presentation	2nd Project Deadline

Mutli-dimensional Arrays








```
A(:,:,1) =

     1     0     3
     4    -1     2
     8     2     1


A(:,:,2) =

     6     8     3
     4     3     6
     5     9     2
```

Logical Variables

MATLAB operator	Description	Example

>	Greater than	`>> c = a > 3`
		`c =`
		`0 0 1 1 1`
		`>> d = a > b`
		`d =`
		`0 0 0 1 1`

>=	Greater than or equal to	`>> e = a >= 3`
		`e =`
		`0 1 1 1 1`
		`>> f = a >= b`
		`f =`
		`0 0 1 1 1`

<	Less than	`>> g = b < 3`
		`g =`
		`0 0 0 0 0`
		`>> h = a < b`
		`h =`
		`1 1 0 0 0`

<=	Less than or equal to	`>> i = b <= 3`
		`i =`
		`1 0 0 0 0`
		`>> j = a <= b`
		`j =`
		`1 1 1 0 0`

==	Equal to	`>> k = a == 9`
		`k =`
		`0 0 0 1 0`
		`>> l = a == b`
		`l =`
		`0 0 1 0 0`

~=	Not equal to	`>> k = a ~= 9`
		`k =`
		`1 1 1 0 1`
		`>> l = a ~= b`
		`l =`
		`1 1 0 1 1`

Import/Export

```
>> clear all;
>> a=[4,2,1,43; 2,5,1,6];
>> b= sin(a)+5;
>> f='test';
>> save test1
>> clear all;
```

```
>> load test1
>> whos
   Name   Size   Bytes   Class    Attributes
   a      2x4       64   double
   b      2x4       64   double
   f      1x4        8   char
>> save('test1','RT1');
```

File format	File content	Extension	Functions
MATLAB formatted	Saved MATLAB workspace	.mat	`load, save`
Text	Text	.txt	`textread`
	Comma-separated numbers	.csv	`Csvread` `csvwrite`
Extended markup language	XML-formatted text	.xml	`Xmlread` `xmlwrite`
Spreadsheet	Excel worksheet	.xls	`Xlsread` `xlswrite`

Random Numbers

- Uniform Distribution

```
>> rand(2)

ans =

    0.1334    0.8875
    0.2043    0.3274
```

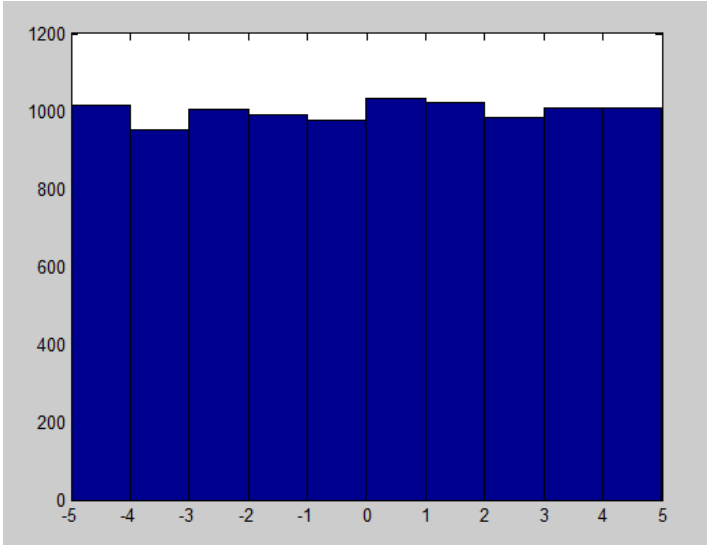
```
>> r = -5 + (5+5)*rand(1,6)

r =

    1.6665    1.0341   -1.2983    0.3298   -1.8825   -3.1169
```

```
>> r = -5 + (5+5)*rand(1,10000);
>> hist(r)
```

```
>> X=rand(size(r))

X =

    0.8594    0.4519    0.5600    0.6888    0.7874    0.7995
```

- Pseudo-random uniformly distributed integers

```
>> r1 = randi(10,1,5)

r1 =

    10     8     8     2     9
```

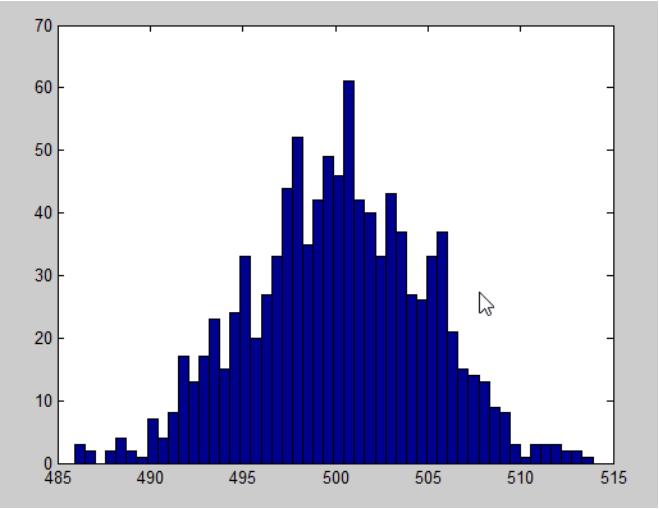


Random Numbers

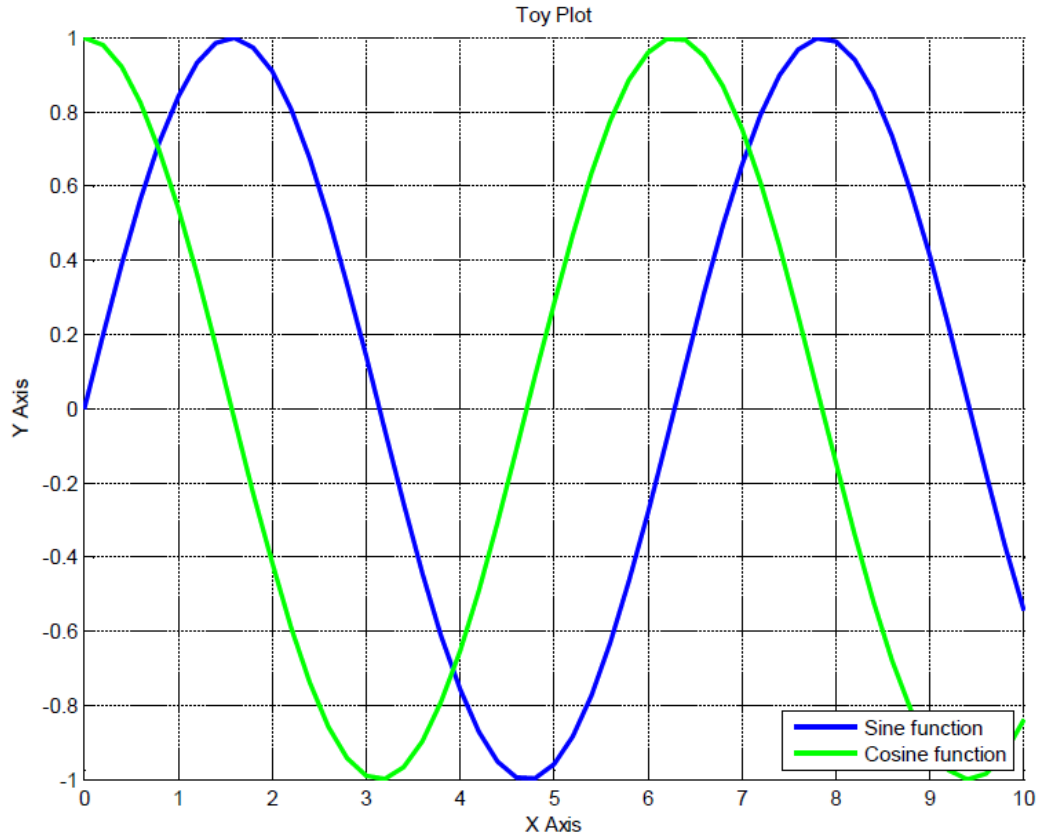
- Normal Distribution

```
>> randn(4)

ans =

   -0.1431    0.6694   -1.3309    0.1598
    0.7559    1.1854    1.0146   -0.2884
    0.1325    0.4229    0.7457   -1.0838
   -1.2572   -1.3795   -0.7116    1.3335
```

```
>> a = 5;
b = 500;
y = a.*randn(1000,1) + b;
hist(y,50)
```



Basics of Plotting

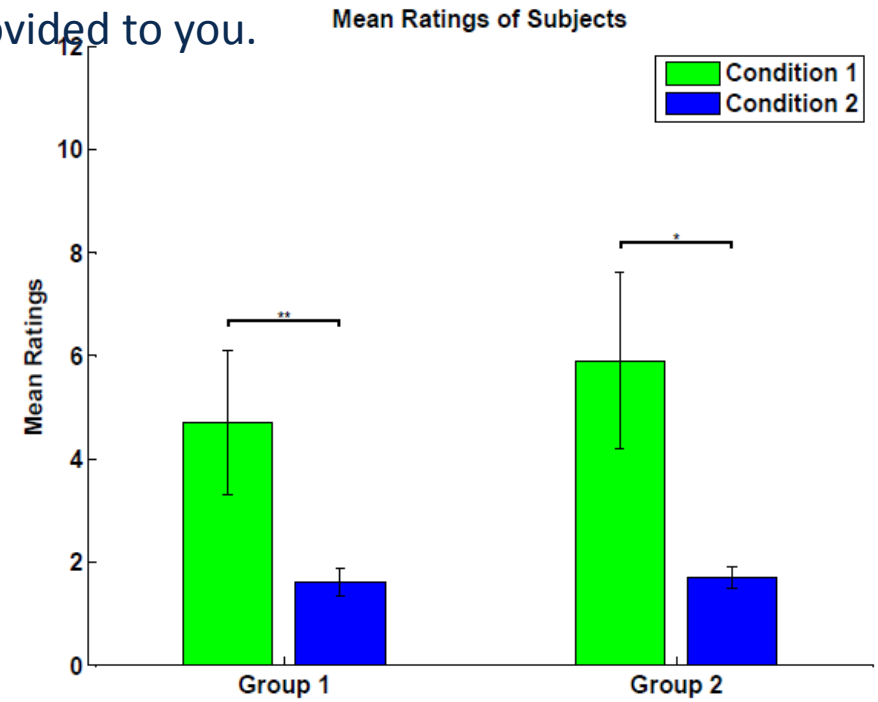



```
>> x=0:0.2:10;
y1=sin(x);
y2=cos(x);
plot(x,y1,'b','LineWidth',2);
hold on;
plot(x,y2,'g','LineWidth',2);
xlabel('X Axis');
ylabel('Y Axis');
title('Toy Plot');
legend('Sine function','Cosine function','Location','Southeast');
grid on
box off
```

Exercise: Multi-subject Data Analysis

- Generate the results of a psychophysical experiment with 5 subjects in each group giving ratings in a specific task for 80 trials per condition, using uniform random distribution.
- Reproduce Plots like below. Error bars should indicate standard error.
- Use barwitherr and sigstar functions provided to you.

```
>> barwitherr(errors, means)
>> sigstar(groups_x_axis,p_values);
```



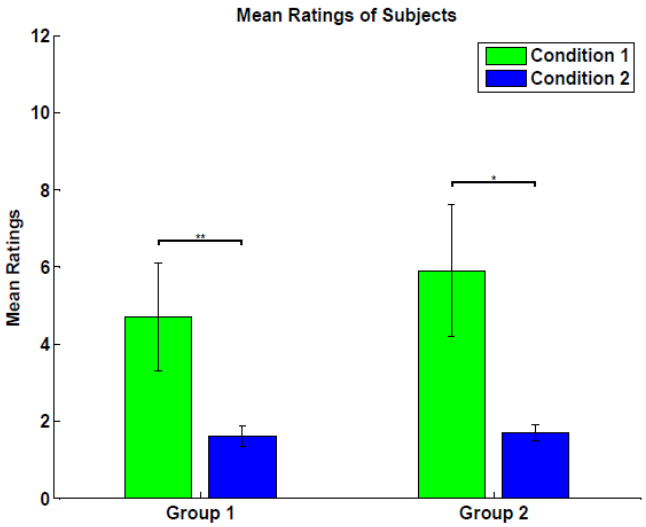
Exercise: Multi-subject Data Analysis

- Generate 80 random integers from a uniform distribution for each subject and put them in a matrix for each (group, condition):
  - Group 1, Condition 1 from the uniform distribution [6 10]
  - Group 1, Condition 2 from the uniform distribution [2 4]
  - Group 2, Condition 1 from uniform distribution [7 10]
  - Group 2, Condition 2 from uniform distribution [1 4]
- Calculate the mean and standard deviation over all subjects and trials
- Use the function below to plot the bar plot

```
>> barwitherr(errors, means)
```

- Use MATLAB plot commands to improve the plot
- Use ttest function to calculate the significance level
- Incorporate the significance level on the plot using sigtar function

```
>> sigstar(groups_x_axis,p_values);
```



References

- **MATLAB for Psychologists (2012),** Borgo, M., Soranzo, A., Grassi, M., Springer-Verlag, 2012, ISBN. 978-1-4614-2196-2.
  - Chapter 2. Data Handling, pp. 25-46.
- **MATLAB for Neuroscientists, 2nd Ed: An Introduction to Scientific Computing (2014),** *Wallisch, P., Lusignan, M.E., Benayoun, M.D., Baker, T.I., Dickey, A.S. and Hatsopoulos, N.G.,* Academic Press, ISBN. 978-0123838360.
  - Chapter 2-3. pp. 7-114.
- **MATLAB help:**
  - http://www.mathworks.com/help/matlab/random-number-generation.html
  - http://www.mathworks.com/help/stats/random.html
  - http://www.mathworks.com/help/matlab/ref/subplot.html