BME 2200: BME Biostatistics and Research Methods

Lecture 4: Graphing data with MATLAB

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Content, Schedule

1. Scientific literature:
- Literature search
- Structure biomedical papers, engineering papers, technical reports
- Experimental design, correlation, causality.

2. Presentation skills:
- Report – Written report on literature search (individual)
- Talk – Oral presentation on biomedical implant (individual and group)

3. Graphical representation of data:
- Introduction to MATLAB
- Plot formats: line, scatter, polar, surface, contour, bar-graph, error bars. etc.
- Labeling: title, label, grid, legend, etc.
- Statistics: histogram, percentile, mean, variance, standard error, box plot

4. Biostatistics:
- Basics of probability
- t-Test, ANOVA
- Linear regression, cross-validation
- Error analysis
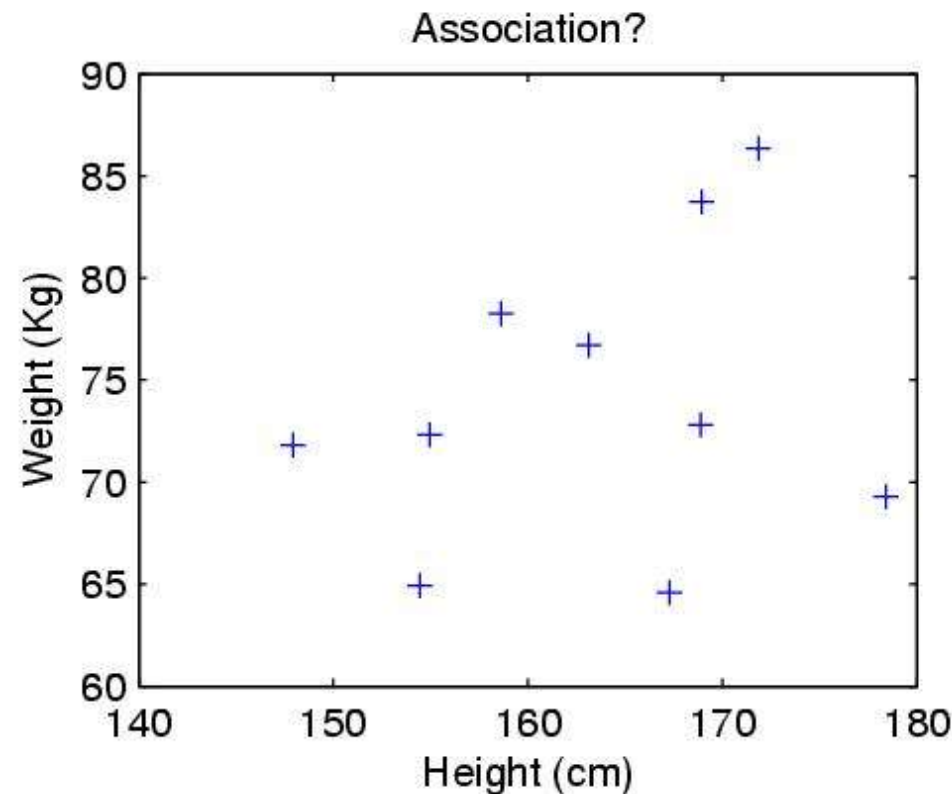- Test power, sensitivity, specificity, ROC analysis

In class observational study

Before we start with plotting data we will collect some **anonymous and voluntary** data: heart pulse rate, height, gender, age, weight.

The objective is to find relations between these variables.

Example

dependent
variable

Association?

Independent variable

3

Introduction to MATLAB

Basic matrix operations
```
y=[ 1, 4, 5]
x=[ 1 2 3; 3 4 5]
x(1,1), x(:,2)
x = [x; y]; x= [x x];
size, length
x'
x.^2
x(:,:,:)
```

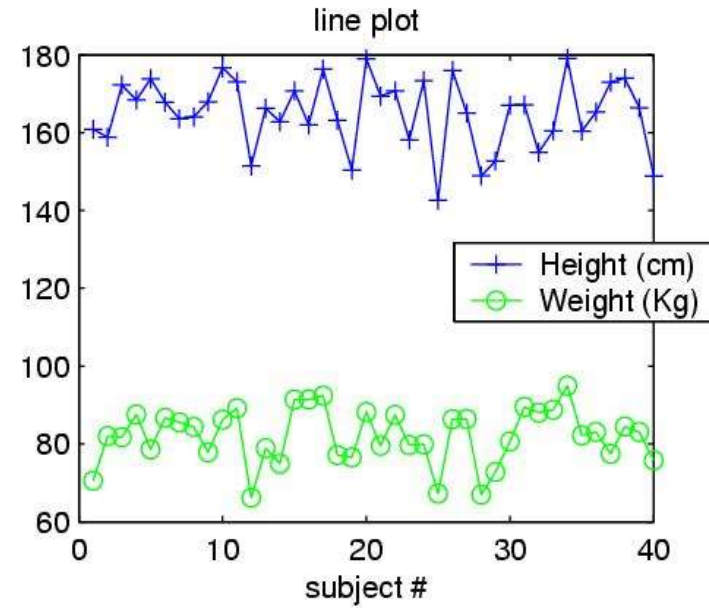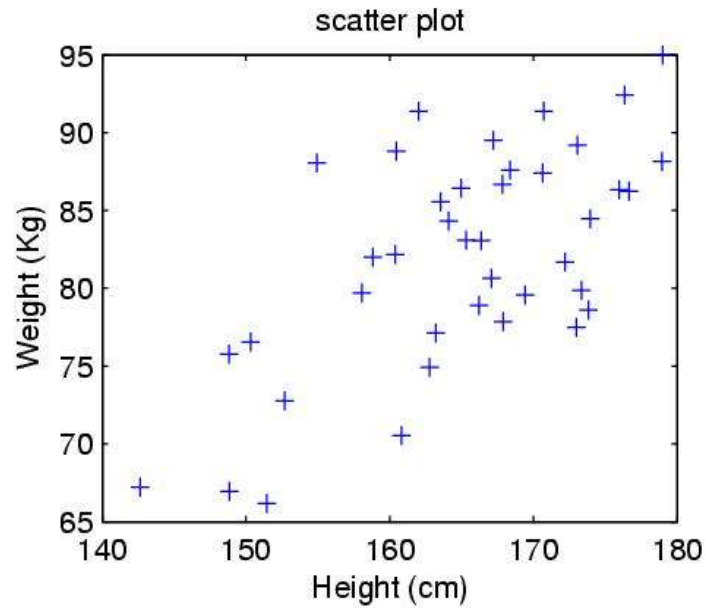**Writing and executing a matlab program**

A program is a simple text files with the same commands as you have typed in the command window with ending .m, e.g. `john_smith_1.m`

Execute `'john_smith_1.m'` by typing in the command window:

```
>> john_smith_1
```
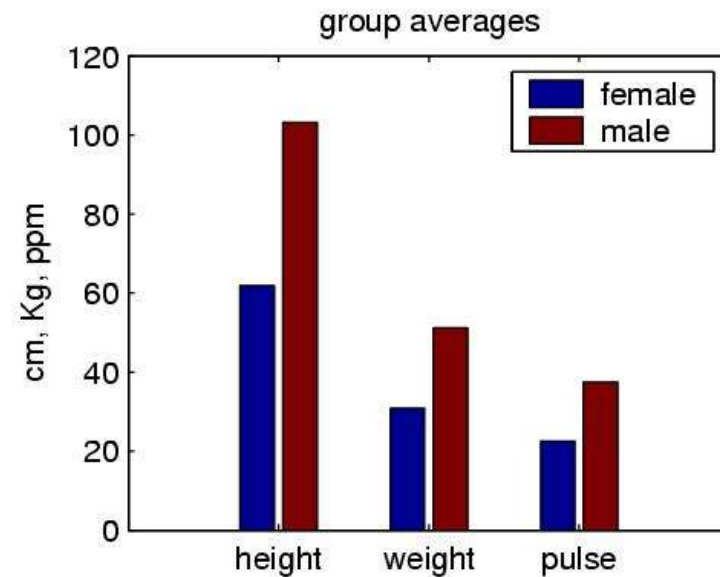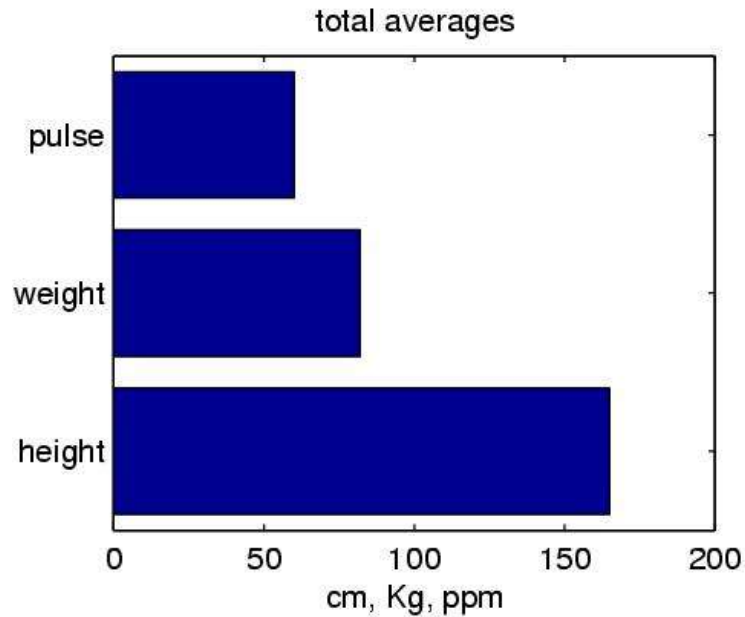
4

Basic line and scatter plot


```
plot(x)
plot(x')
plot(x,y)
plot(x,y,'+')
plot(x,y,'g')
plot(x(:,1),y(:,1),'+b');
hold on
plot(x(:,2),y(:,2),'or');
hold off
```
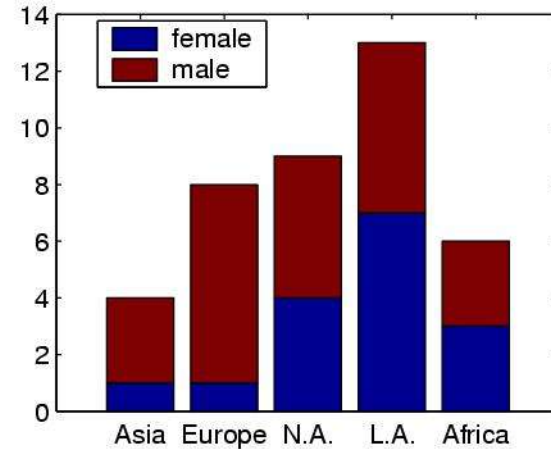
Basic bar graphs
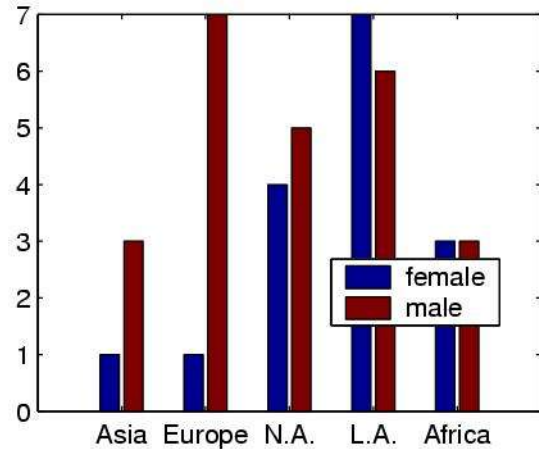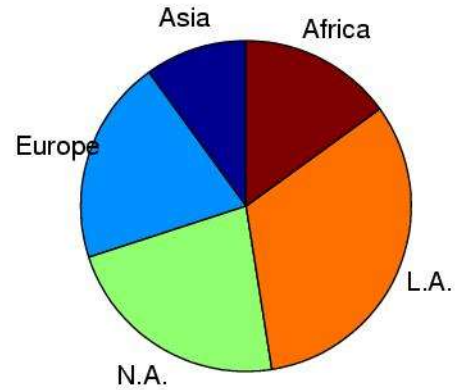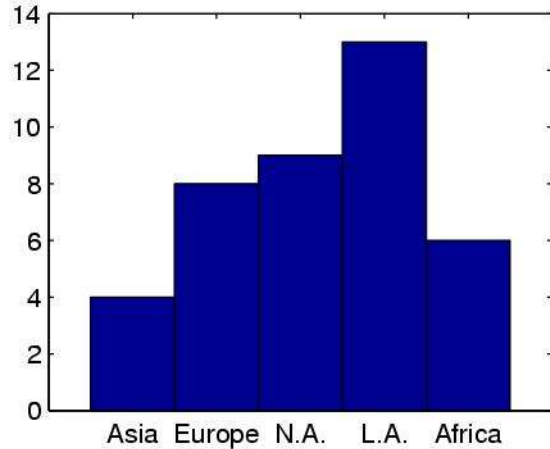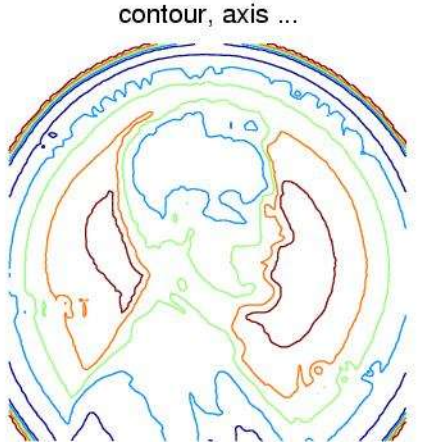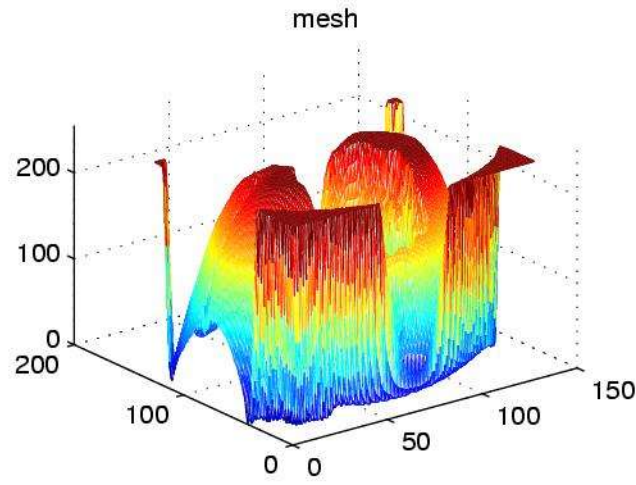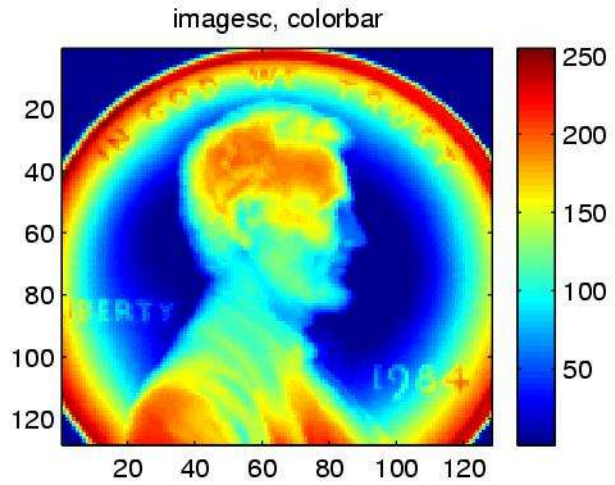


```
subplot(2,2,1)
barh(mean([height weight pulse]))
subplot(2,2,1)
bar([grp_height; grp_weight; grp_pulse]),
```

Basic bar graphs


```
pie, bar, hist,
legend, set(gca,'xticklable',labels)
```

Basic 3D graphs

Labeling, axis, color, printing, etc.

```
xlabel, ylabel, title, legend,

gtext, ginput

subplot, suptitle,

xlim, ylim, axis,

colorbar, colormap, caxis

saveas, print
```

Changing any property of a figure

`get, set`
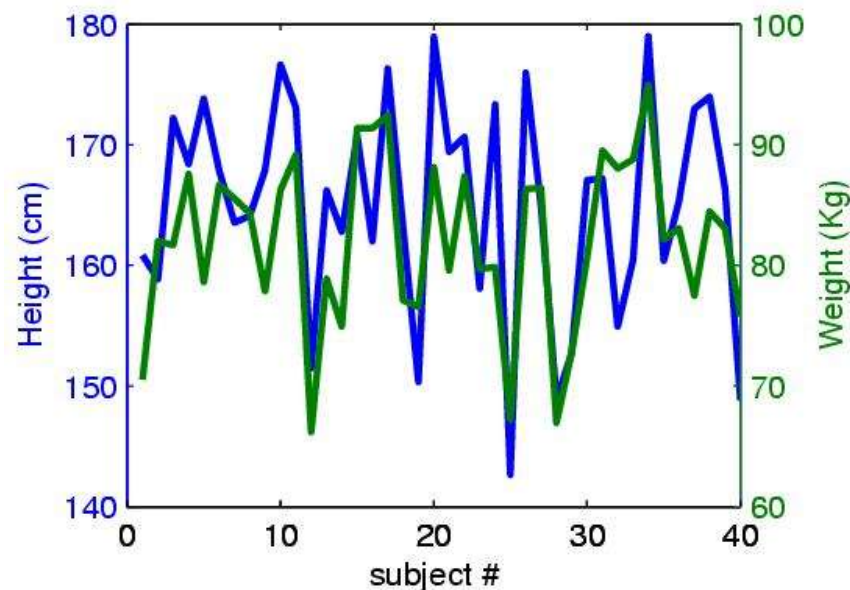
```
ax=plotyy(1:N,height,1:N,weight);
set(get(ax(1),'ylabel'),'string','Height (cm)')
set(get(ax(2),'ylabel'),'string','Weight (Kg)')
set(get(ax(1),'children'),'linewidth',2)
set(get(ax(2),'children'),'linewidth',2)
```

Assignment 5: Write a matlab program that generates figures in slides 5, 6, 7, 8, 10 using the data we collected in class. Do not use all the same data to plot, we have pulse, age, height, weight, etc.

Loading, Saving, Importing, Exporting

```
load, save

textread

fread, fwrite

imgread, xlsread, ...
```

Programing Assignments (read carefully!)

- **If you copy code you will fail the course.**

- Due one week after assignment. Submit by email **before class**.

- Submit **single executable file** called: first_last_number.m, all lower case e.g. john_smith_3.m for John's 3rd assignment. No figures, no text files, nothing except executable code.

- Your program must load all required data. Assume that data files are in current directory. All required data will be posted on the web.

- Include `clear all, close all` at the beginning of all programs.

- **Do not use upper case** letters for commands, e.g. Use `axis()` instead of `AXIS()`. They may work for you but they don't work for me!

- If you had help during your work, you **MUST** name your partner. **"Similar" submission are easy to spot.** *Undisclosed collaborations* receive 0 credit.

- The criteria for full credit should be clear. If not, please ask in class. Do not take chances by assuming that your work is "sort of correct".

Where to get more help on MATLAB

For help on MATLAB run   Useful functions
```
>> demo                                   >> lookfor
>> help                                   >> whos
```

Familiarize yourself in particular with the set of graphing functions:

```
>> help graph2D
>> help graph3d
>> help graphics
>> help specgraph
```

If you are new to MATLAB, please make substantial time available to run the demo programs which are a very good introduction:

basic matrix operations   line plotting
matrix manipulations   2-D plots
graphs and matrices   axis properties,
MATLAB language introduction   desktop environment demos