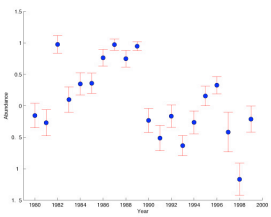
Figures & Axes, Printing & Saving

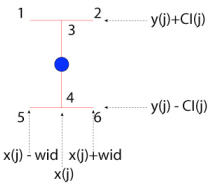
Outline

- Announcements
  - Homework I on web, due Wed. 5PM by e-mail
- A word on HWI and cookies
- What happens when you plot
- Figures
- Axes
- Printing and saving

HWI

- Programming problem: add confidence intervals:
  - H=plotCI(x,y,CI)



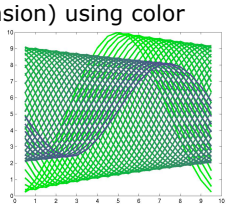


Cookie Challenge

- Your function must return handles to any objects it creates
  - Handle(s) to dots at x,y
  - Handle(s) to CI lines
    - Fairly easy to create each CI line as a unique object (20 handles for example)
    - But, I think it is possible to create CI lines as a single object (1 handle)
  - Anyone who figures out 1-handle problem will win a cookie
    - Ties will be decided by programming style
      - Comments, error checking, elegance, speed

colortime

- Example on plot/colortime on web site
- Colortime shows time (or any 3rd dimension) using color



What happens when you plot

- We know that plot(x,y) produces a line object
- We also know that we can get a handle to the object and change its properties
- But, other things happen too:
  - A new window is created (a "figure")
  - A white rectangle is placed in the window (an "axes")
  - The rectangle has ticks and numbers attached to it
  - The line object is placed on the rectangle

Figures and Axes

- Figures and axes are also objects
- We can get handles to them and change their properties
- These objects are created as needed when graphics routines are called
  - They can also be created explicitly

Figures

- If no figures are open, Matlab will create one when you call a graphics routine
- If a figure is open, then any subsequent graphics will be placed in that figure
- Figures can be created explicitly by calling figure
  - h=figure; --creates a new figure, handle saved in h
- Figures can be cleared with clf

Multiple Figures

- If multiple figures are open and you call plot, where does the new line go?
  - One of the figures is the "current figure"
    - the current figure is the last one you plotted into or the last one created
    - the function gcf returns a handle to the current figure

Multiple Figures

- More ways to use figure
  - figure(n)
    - if figure number n doesn't exist, then it is created
    - if it exists, then it becomes the current figure
    - regardless, it will be the current figure
  - figure(h)--changes current figure to h (a figure handle)
- Delete figures with close
  - close(h)--closes figure with handle h
  - close(n)--closes figure number n
  - close all closes all figures

Figure Properties

- Lots of properties, the interesting ones are
  - color--color of figure (usually gray)
  - colormap--specifies colors for 2D plots
  - Paper stuff--controls how figure maps onto printer page

Figure Properties

- Position--[llx,lly,width, height]
  - (llx,lly) is the position of the lower-left corner
- Renderer-- 'painters', 'zbuffer', 'OpenGL'
  - algorithms used to display the graphics
- Units-- 'pixels' or 'relative' --units used to specify position

Axes

- Figures can only contain axes (and some special GUI stuff)
- Axes can contain anything (except figures, axes, and some GUI stuff)
- Axes are created if needed
- Can be created explicitly with axes
  - axes -- creates default axes (most of figure)
  - axes('position',[llx,lly,width, height])--creates axes with specific position
  - can return handle to the new axes

Multiple Axes

- If several axes exist on gcf, where does your plot go?
  - One of the axes is the "current axes"
    - The current axes is the last one you plotted into or the last one created
    - The function gca returns a handle to the current axes
    - Switching gcf will switch gca

Multiple Axes

- In many ways, axes and figures are managed the same way, but…
  - axes are not numbered in any intelligible way, so axes(1) is meaningless
  - If you have multiple axes, you must save their handles and switch axes using axes(h)
  - Matlab's subplot command returns some of this functionality (example in a minute)

Axes Properties

- Box--on/off --switches box around axes on and off
- Camera stuff--controls how the objects in axes are viewed
- Clim--limits for color mapping
- Color--color of the axes (usually white)
- Font stuff--controls fonts on labels
- Line stuff--properties of the axes lines (options for grid lines)

Axes Properties

- NextPlot-- 'add', 'replace', 'replacechildren'--what happens to objects in axes when a new one is created
  - default is replace--old stuff is deleted
  - can change to add using "hold on" or replace using "hold off"
- Position--controls where the axes goes in figure
- Tick stuff--controls properties of tick marks
- Title--handle of text object with axes title
  - title('axes title') will title the axes
- Units--several options, default is normalized

Axes Properties

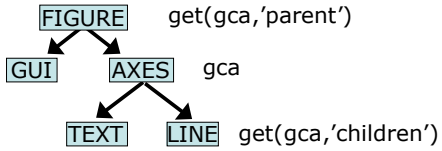
- Axes have 3 axes: X (horizontal), Y (vertical), Z (height)
- We can control the range and appearance of each
  - XColor--color of the axis lines
  - XGrid--on/off turns grid lines on or off
  - XLabel--handle of text object with x axis label
    - xlabel('x label') will label the x axis
  - XLim--range of the x axis
    - cas set xlim and ylim togther with axis command
  - XScale--linear/log --can plot on a log10 scale

Axes Properties

- Xtick--where the tick marks (and labels) occur
- XTickLabel--the labels
  - Matlab works hard to pick "good" labels (base 10)
  - Can change labels by setting ticklabel
    - set(gca, 'xticklabel', 'first|second|third')
- Setting Xtick or XTickLabel will change XTickMode or XLabelModes to 'manual'--may give problems if figure is resized

Handle Tree

- Matlab organizes graphics like a tree
- The parent and children fields allow you to traverse the tree



Example--subplot vs. multiax

- You can produce mulitple axes laid out in a regular fashion using subplot
  - subplot(m,n,j) produces the jth axes from an m-by-n grid of axes

1	2
3	4
5	6

subplot(3,2,4)

  - if subplot(m,n,j) exists, then calling it will set gca to this axes
  - h=subplot(m,n,j) returns the handle to the jth subplot

Criticisms of subplot

- Numbering is consistent with English, but not with Matlab
- Too much white space--gets ugly if m or n are big
- [fax,ax]=multiax(m,n,{limits}) is a "flexible, hands-on" alternative to subplot
  - Fax=handle to invisible axes encompassing whole figure
    - useful for annotating figure
  - ax=m-by-n matrix of handles to the m*n subplots
    - numbered "correctly"
  - limits allows you to control space around axes

1 (1,1)	4 (1,2)
2 (2,1)	5 (2,2)
3 (3,1)	6 (3,2)

Printing and Saving

- Print through GUI or command line
  - print -depsc fname.eps will save gcf to an EPS file
  - print -djpeg fname.jpg will save gcf to a JPEG
  - Can also save figure to a .fig file from the GUI
    - Opening the file (from GUI) will recreate the figure