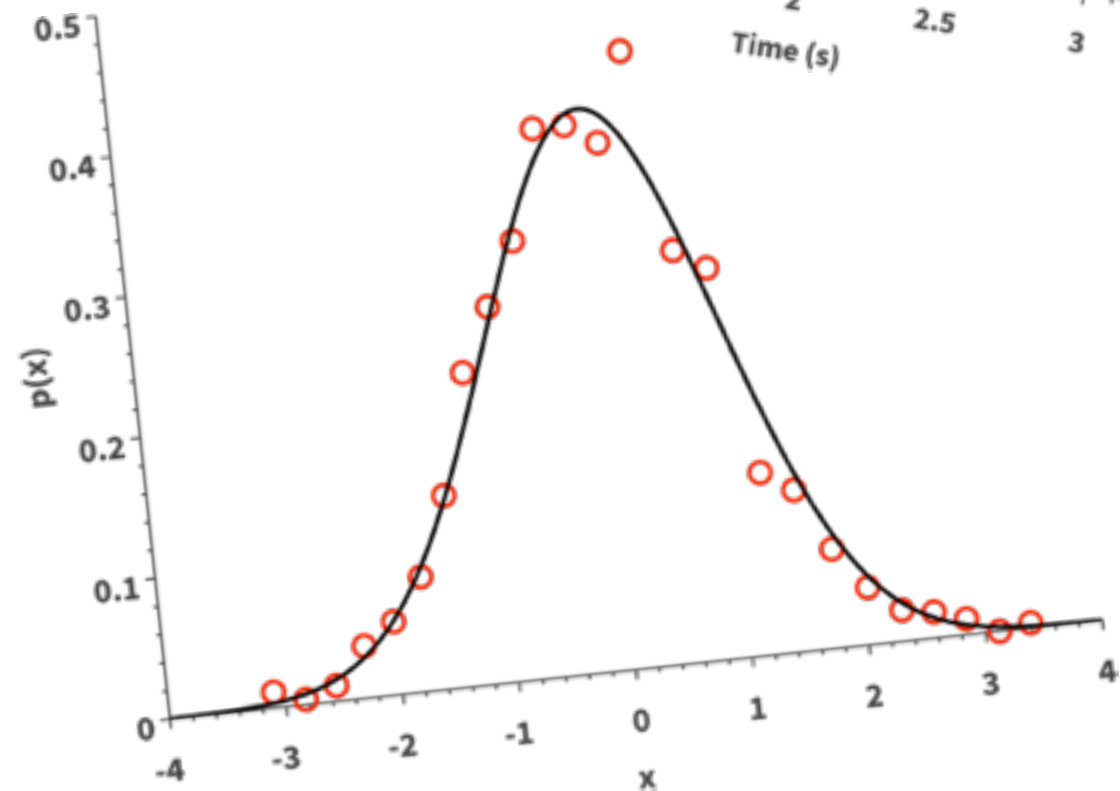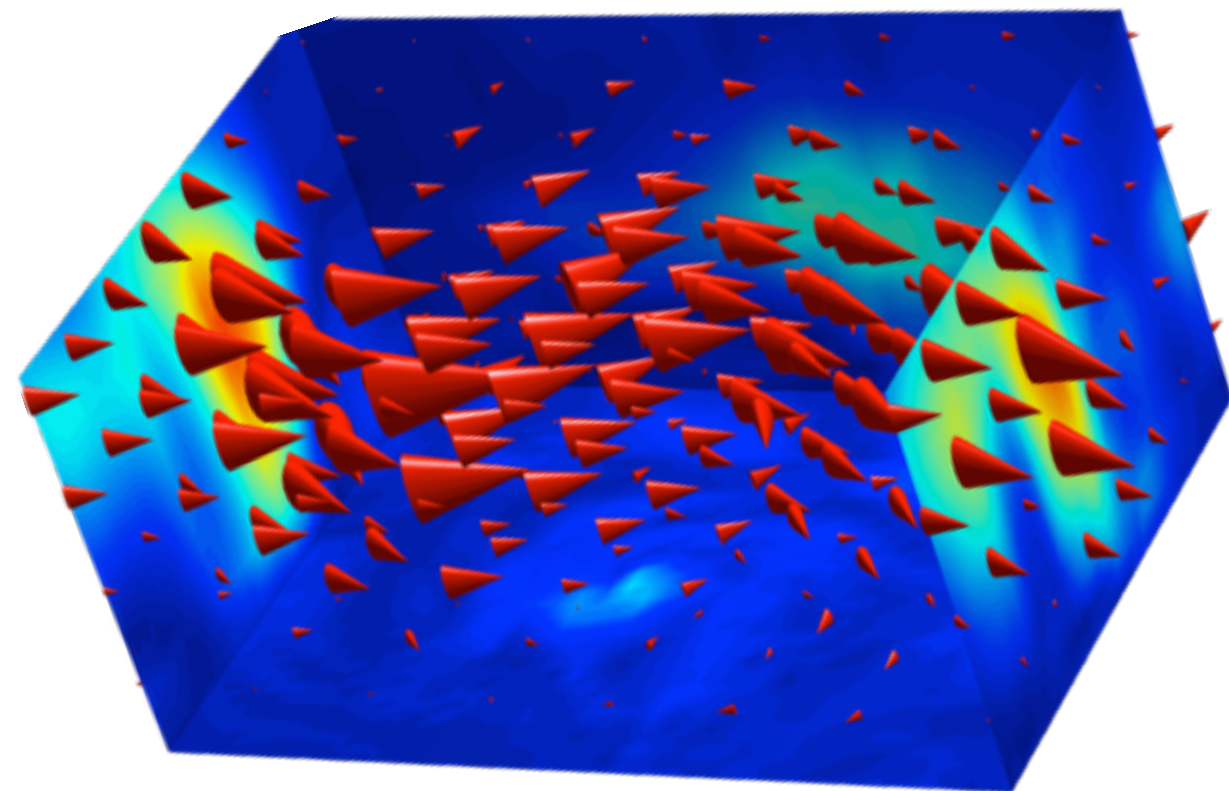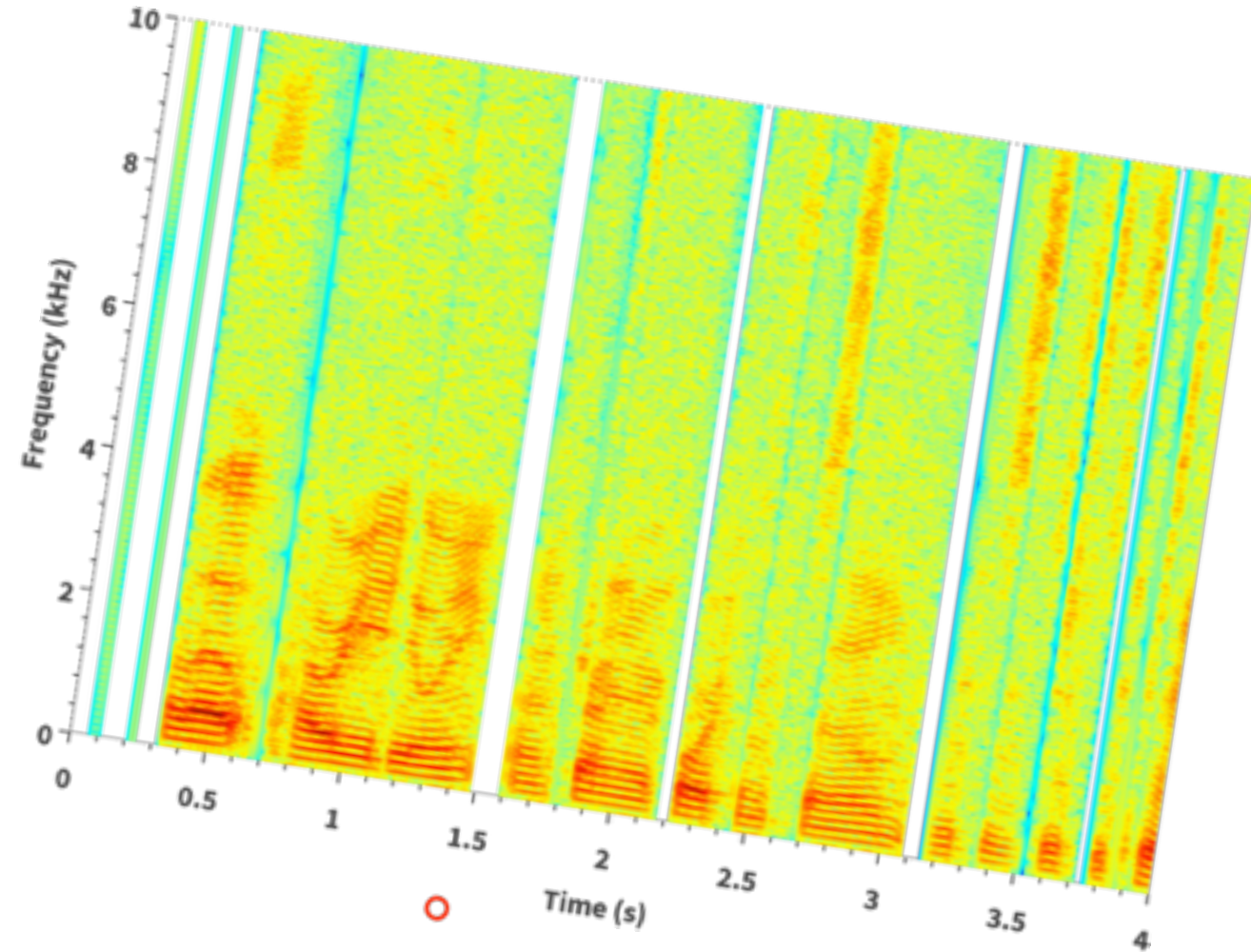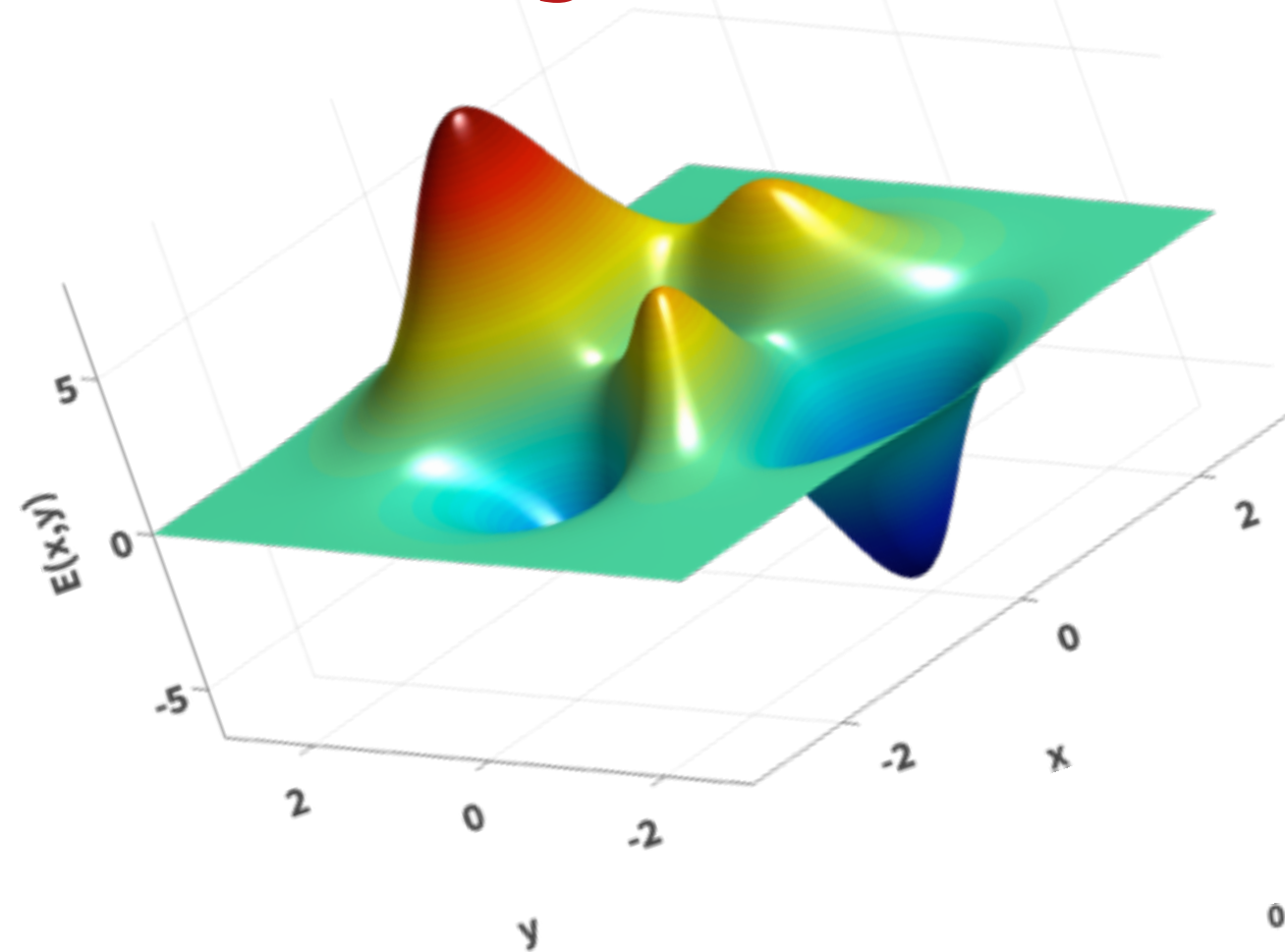# Lecture 4: Visualization

Outline

- Basic plotting commands

- Types of plots

- Customizing plots graphically

- Color

- Figure formats

- Customizing plots programmatically

Why visualization in Matlab?

Matlab is **flexible** enough to let you quickly visualize data, and **powerful** enough to give you complete control over the final product

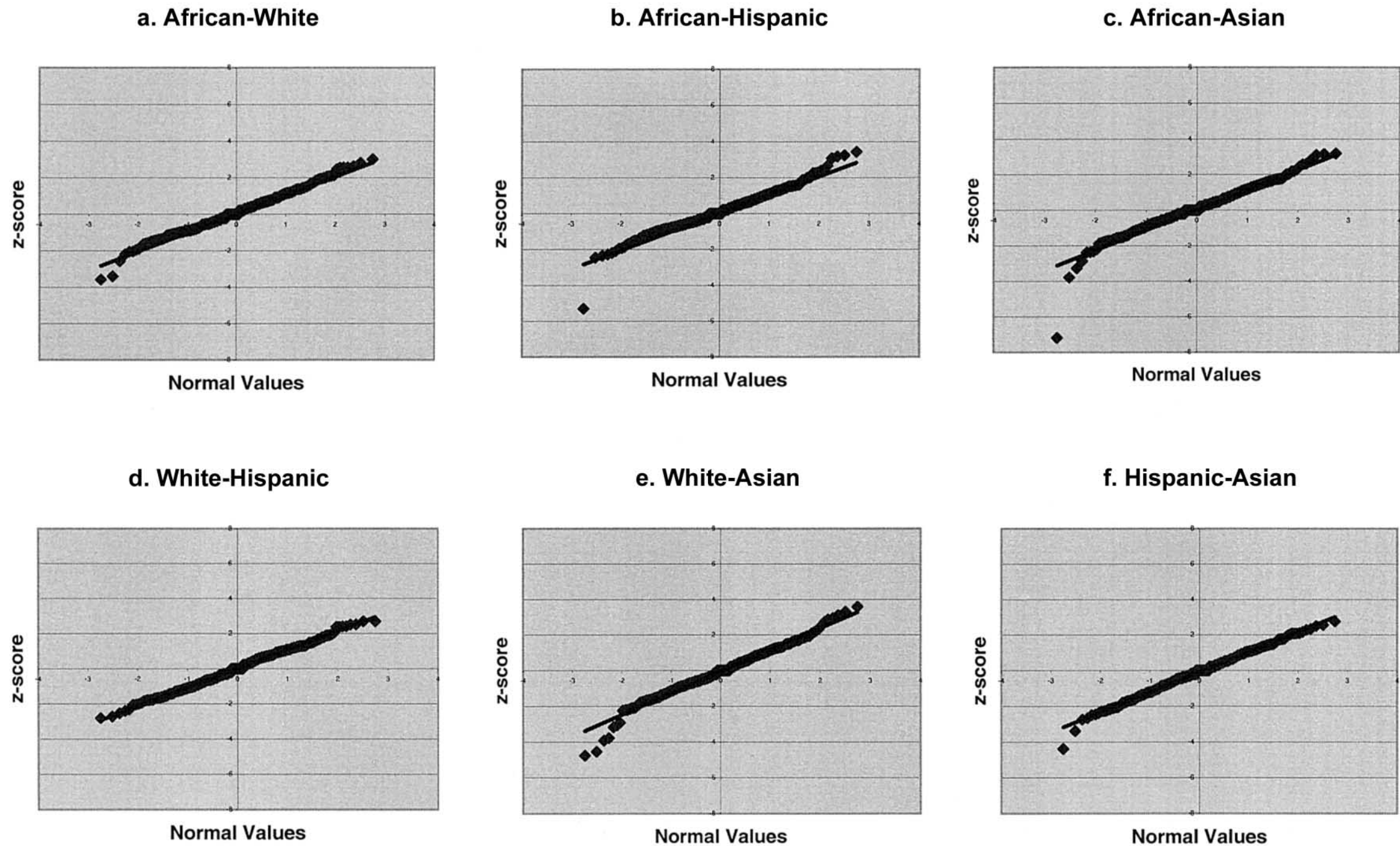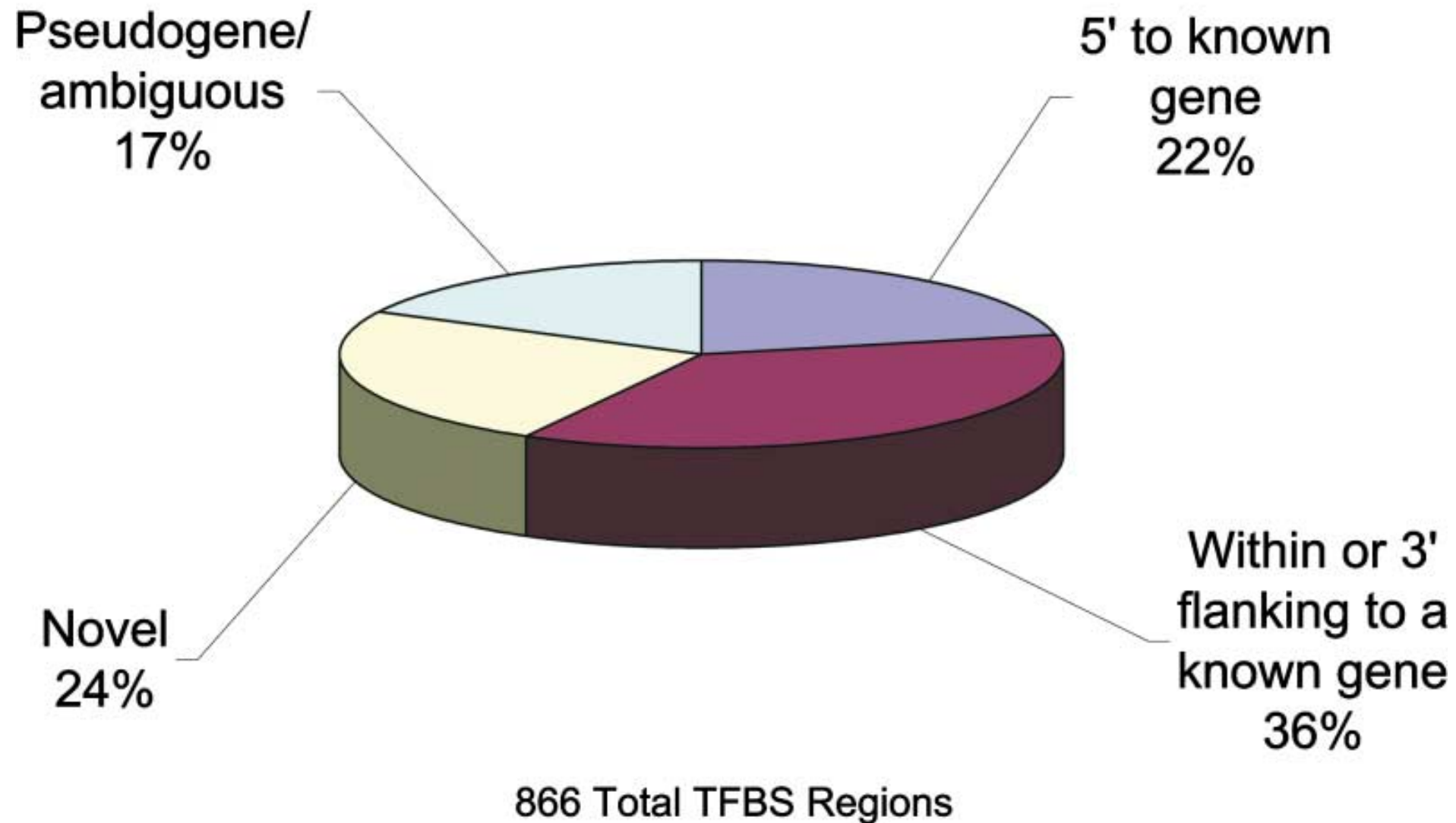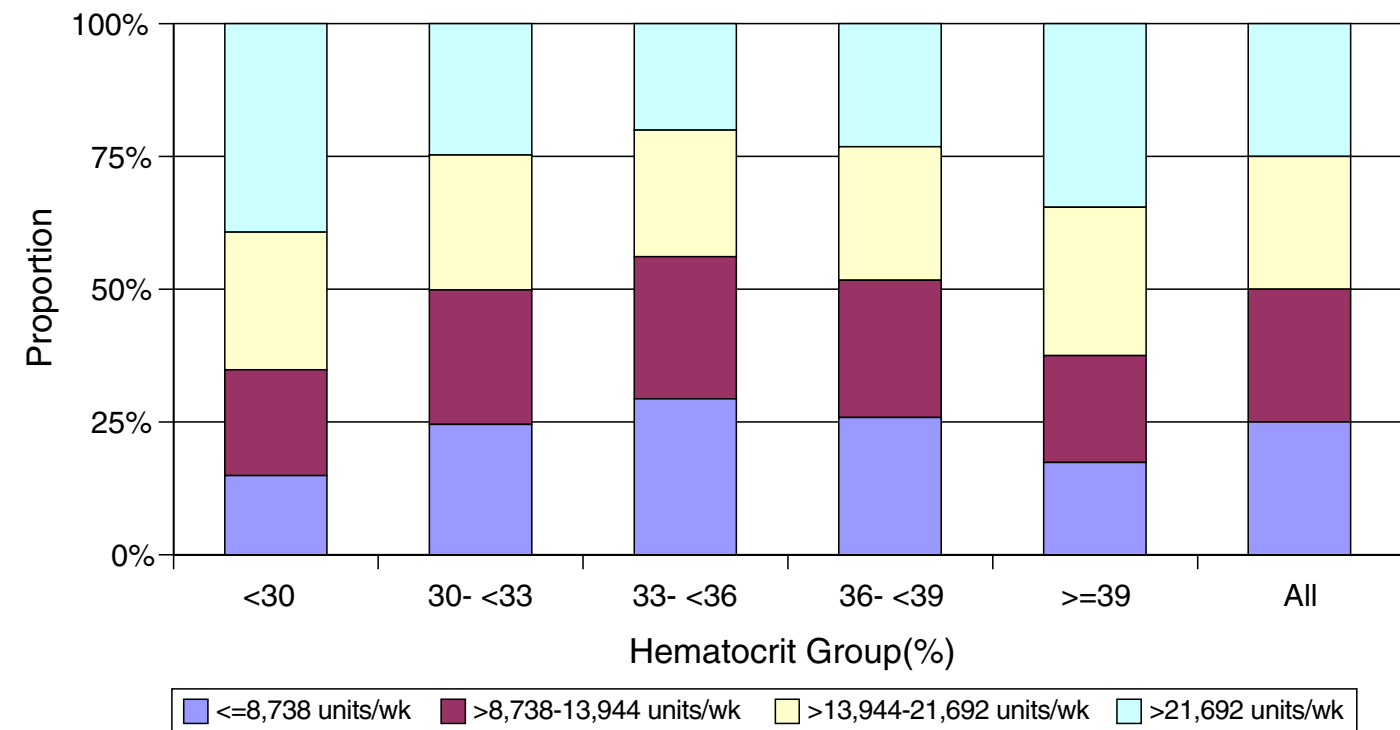# Why visualization in Matlab?

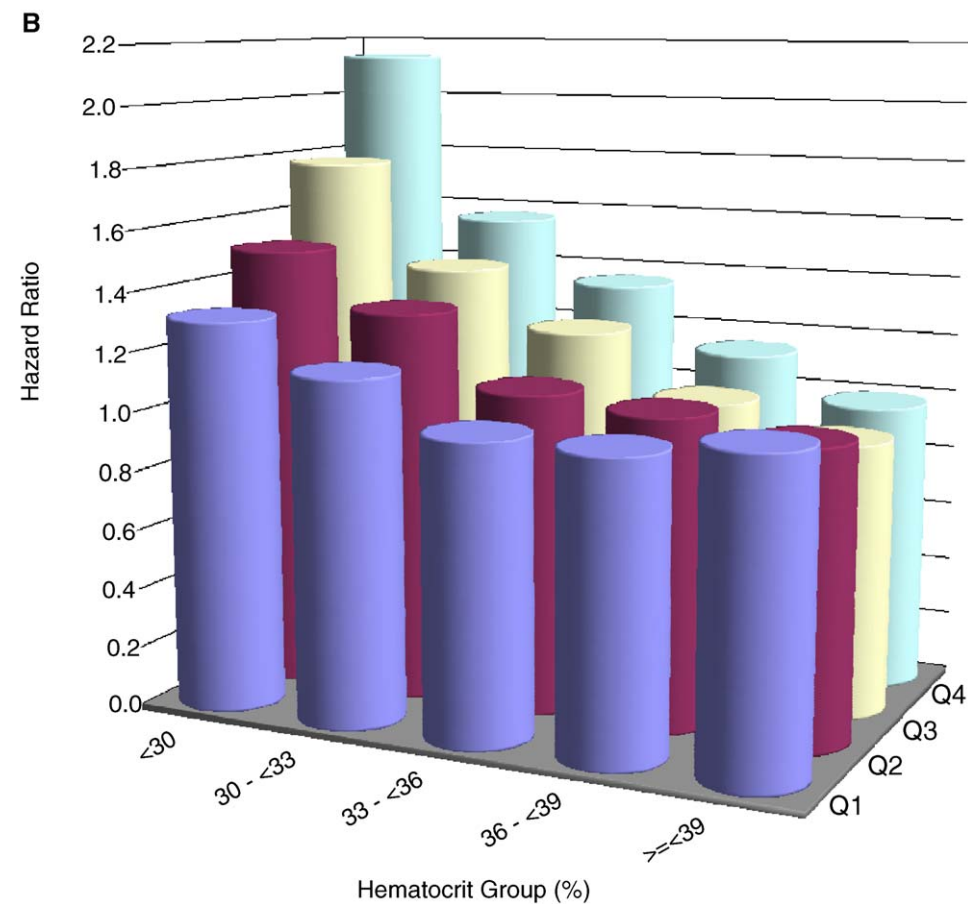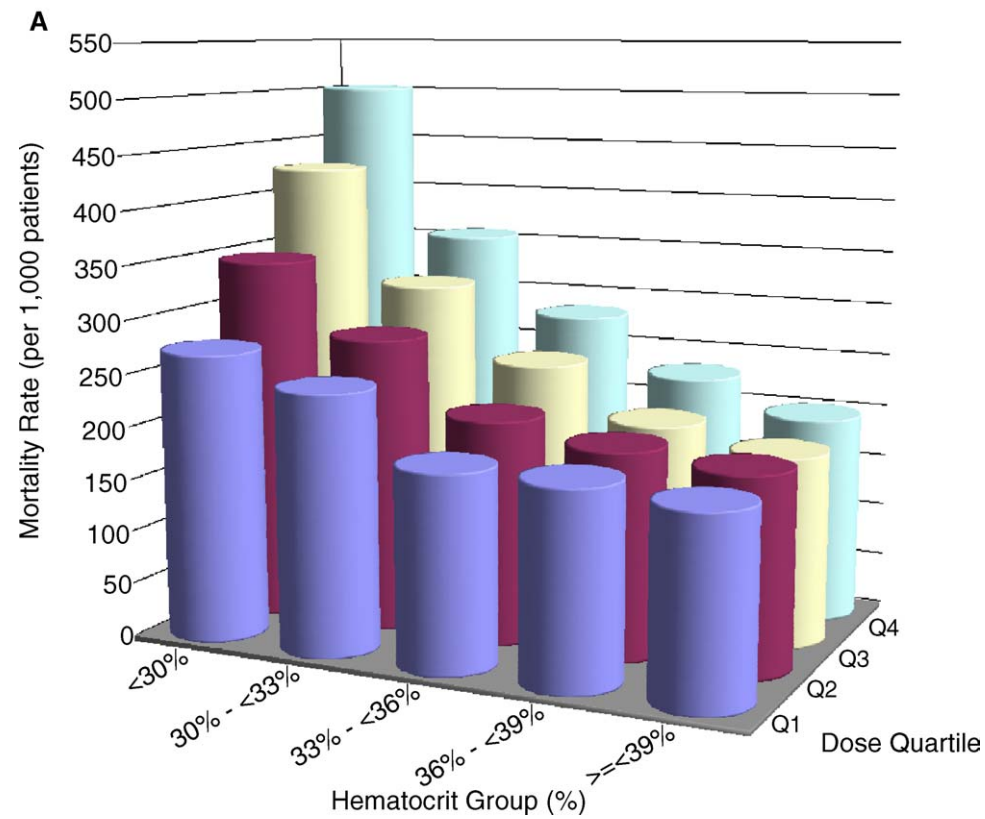# Poor Graphs

Figure 1   Q-Q plots of *Z* scores for individual interval-length differences between racial/ethnic groups. *a*, African Americans versus whites. *b*, African Americans versus Hispanics. *c*, African Americans versus Asians. *d*, Whites versus Hispanics. *e*, Whites versus Asians. *f*, Hispanics versus Asians.

Jorgenson et. al., Am J Hum Genet. 2005 February; 76(2): 276–290.

Poor Graphs

Distribution of All TFBS Regions

Pseudogene/ambiguous 17%

5' to known gene 22%

Within or 3' flanking to a known gene 36%

Novel 24%

866 Total TFBS Regions

Poor Graphs

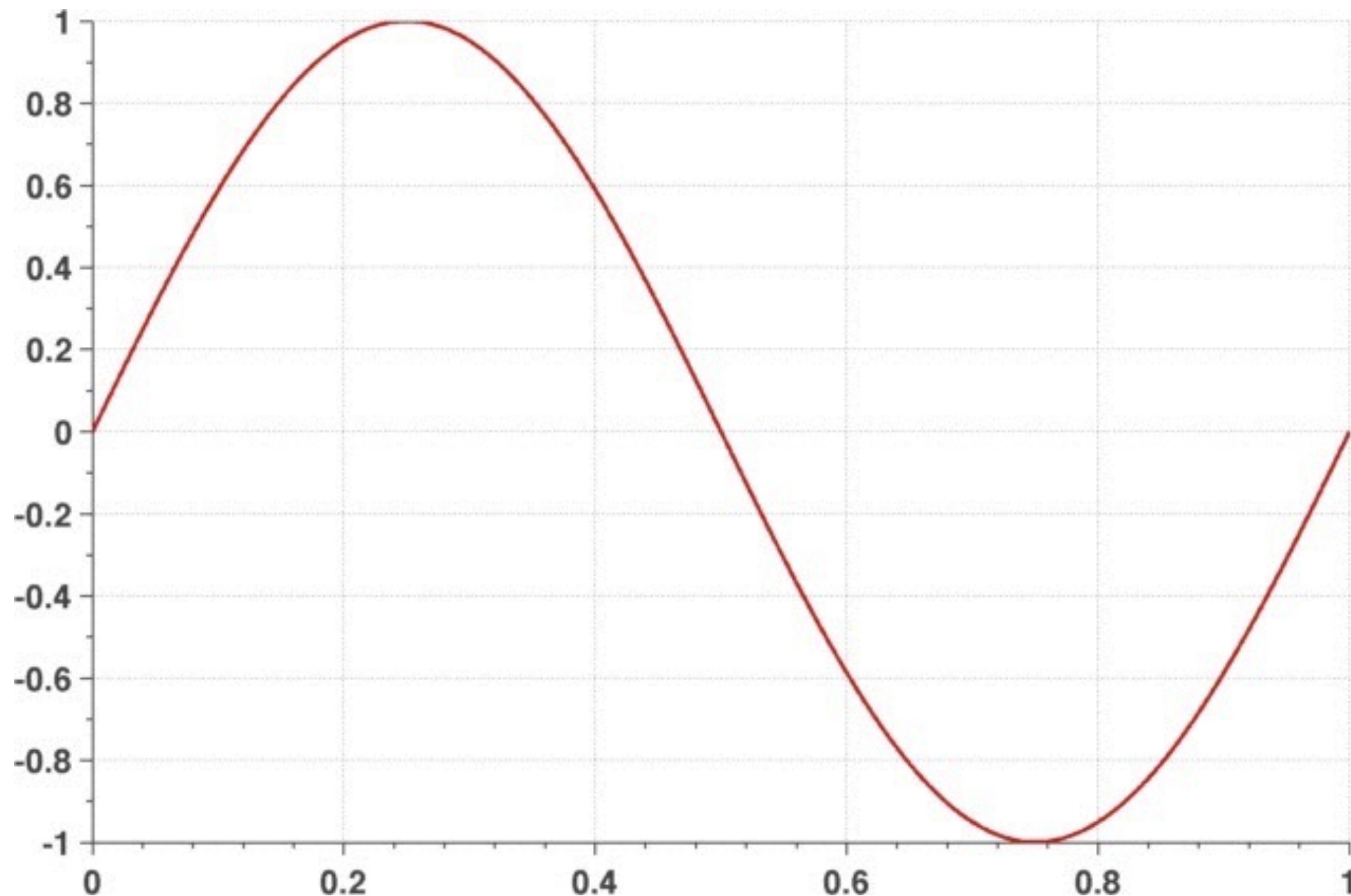Cotter et. al., Journal of Clinical Epidemiology 57 (2004)

Types of Plots

- 2D Visualization
    - `plot` (line plots)
    - `image/imagesc` (images)
    - `bar` (histograms)
    - `scatter` (scatter plots)
- 3D Visualization
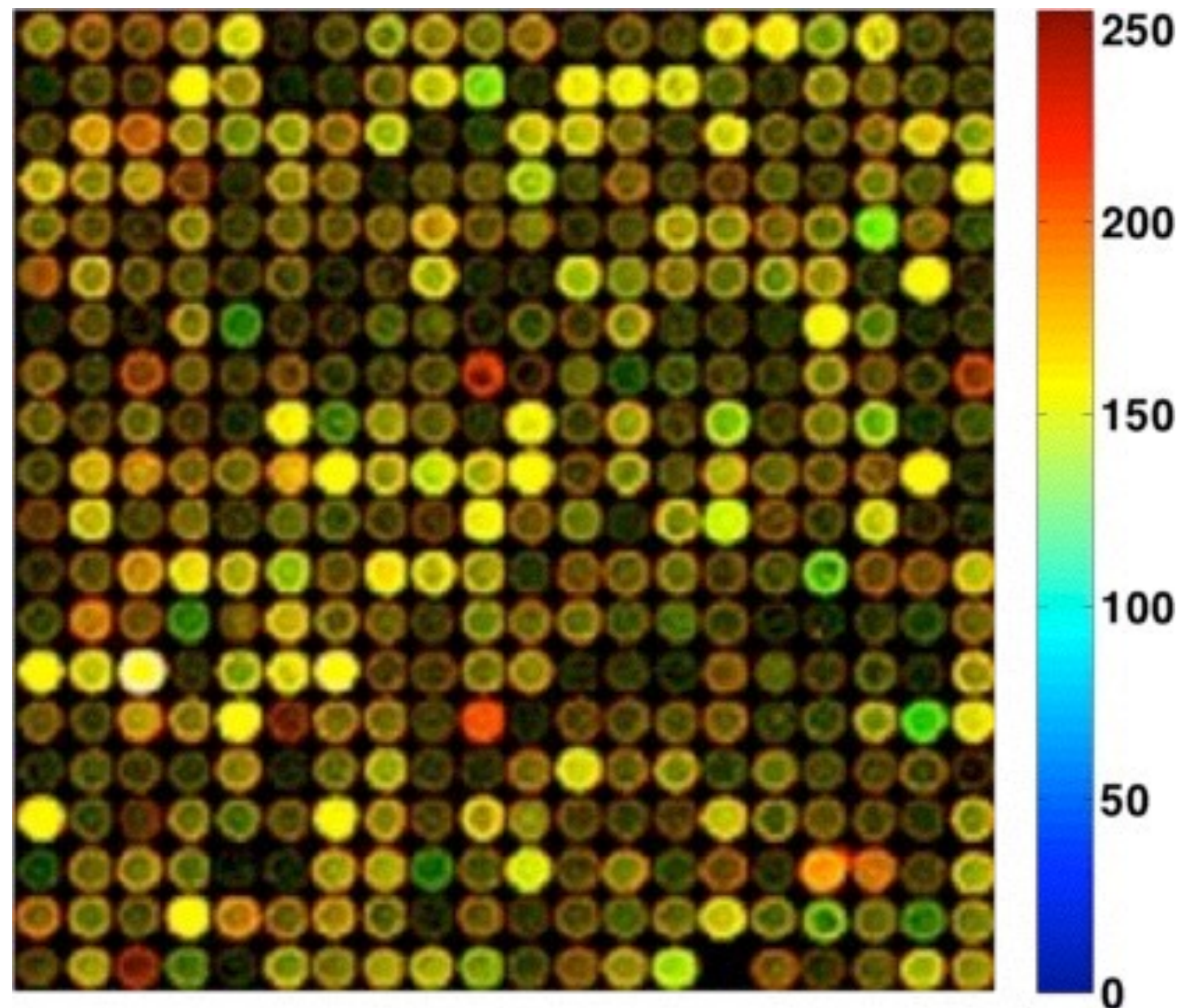   - `surf/mesh` (surfaces)
    - `plot3` (lines)

plot

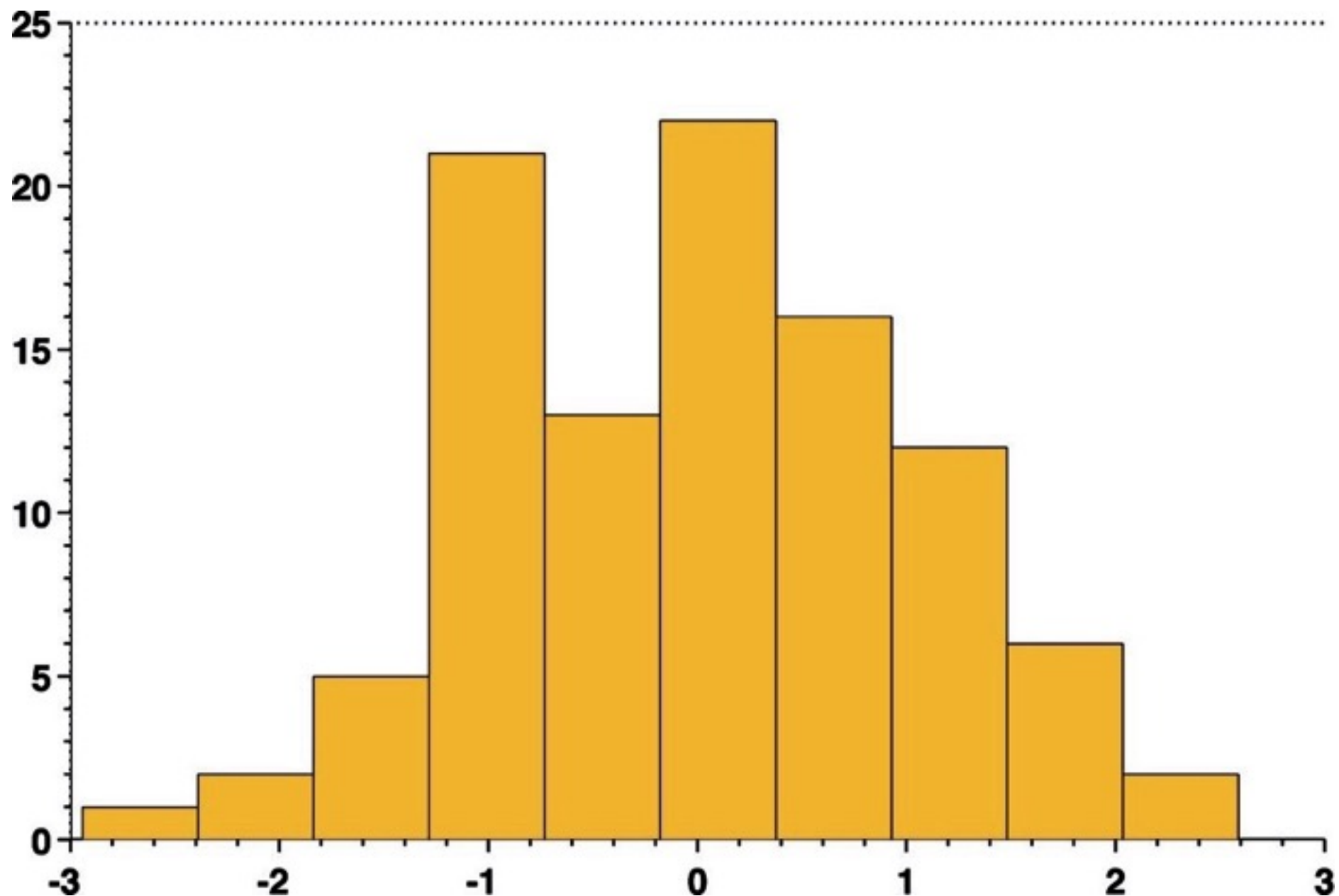- Syntax: plot(x,y) plots points in the vector y against points in the vector x

image/imagesc

- Syntax: image(C) plots the values stored in the matrix C as an image

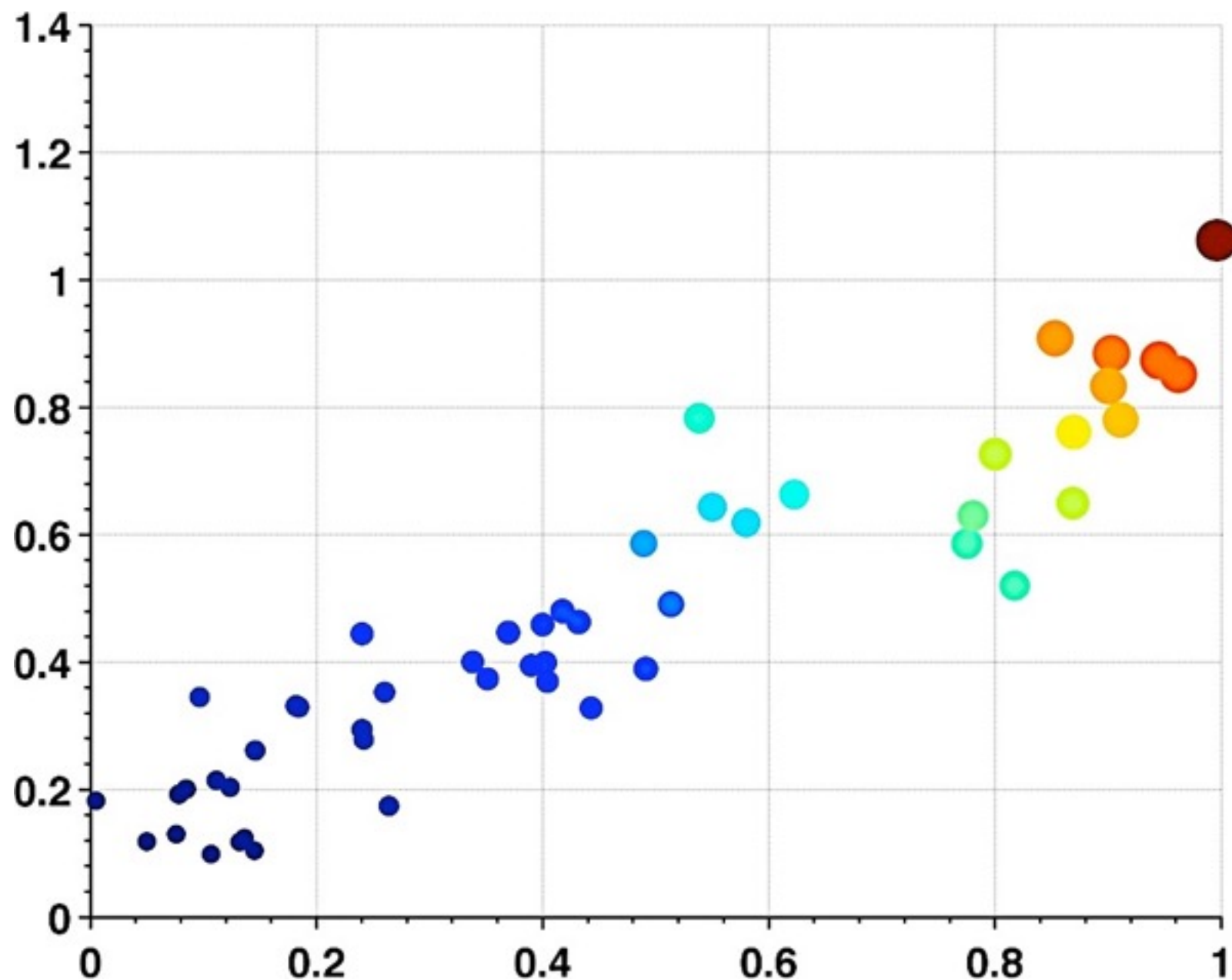# hist/bar

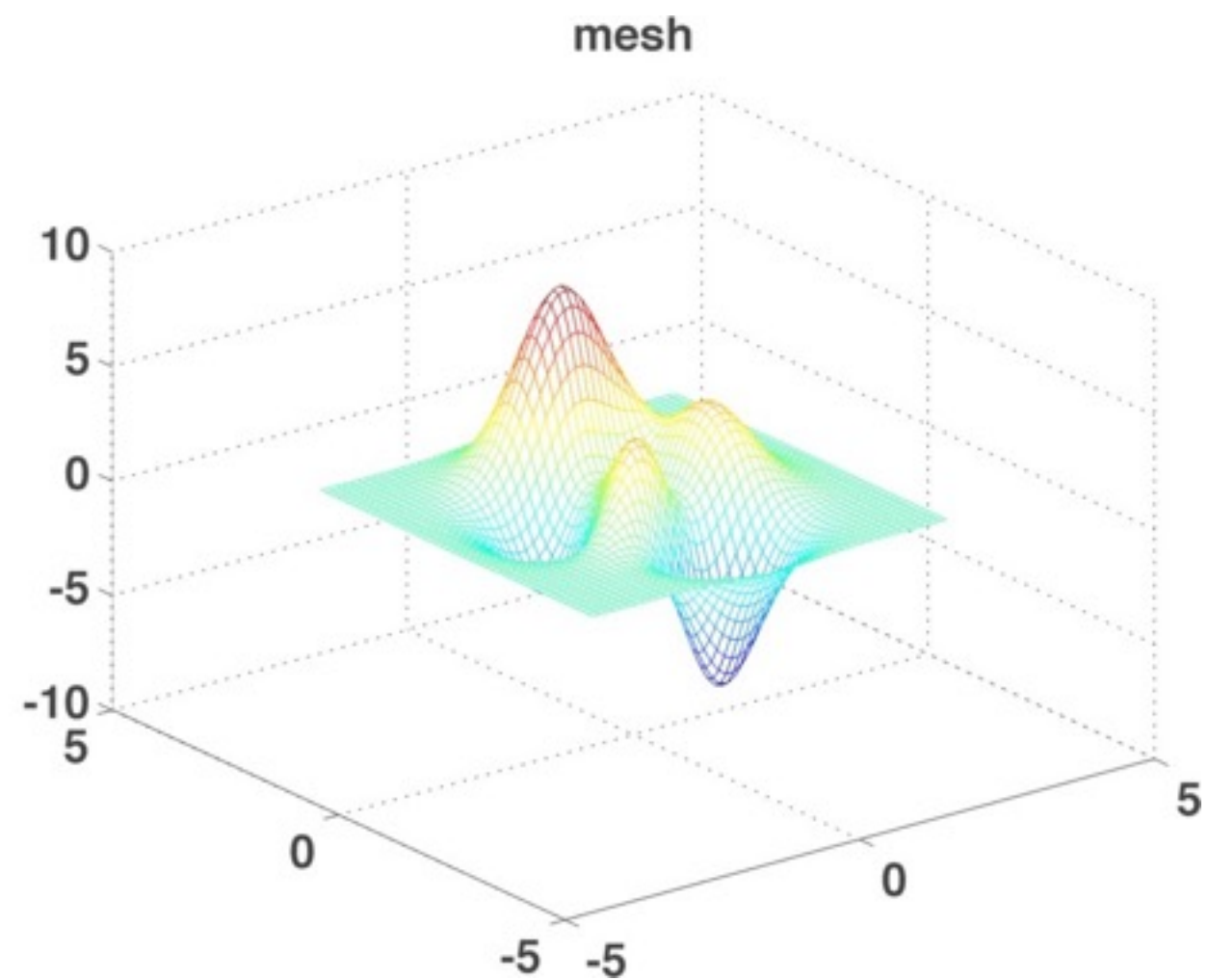- Syntax: hist(y) plots a histogram of the values in y, bar(x,y) plots bars at the points given by (x,y)
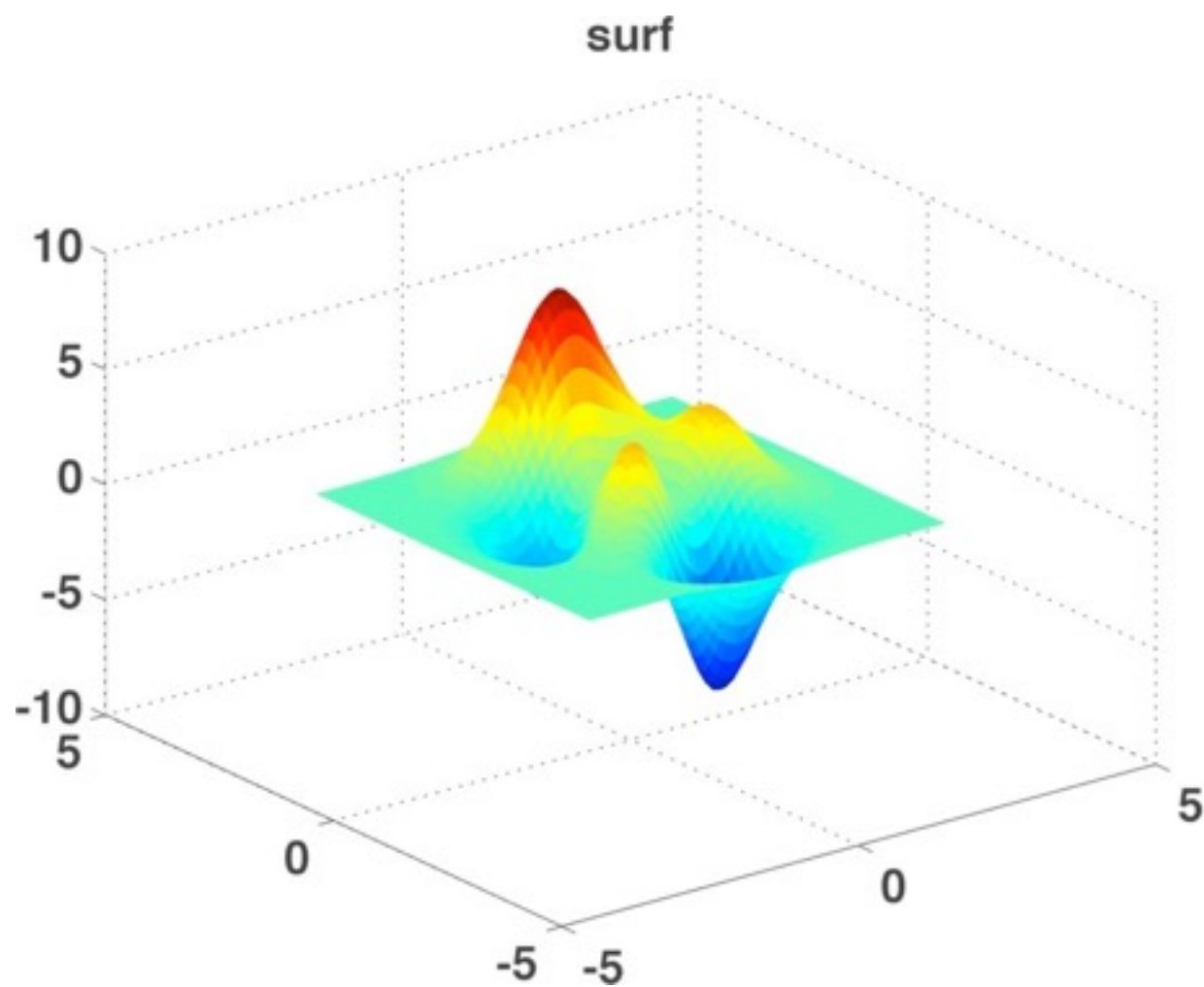
scatter

- Syntax: scatter(x,y,s,c) lets you specify the size (s) and color (c) of each point given by (x,y)

surf & mesh

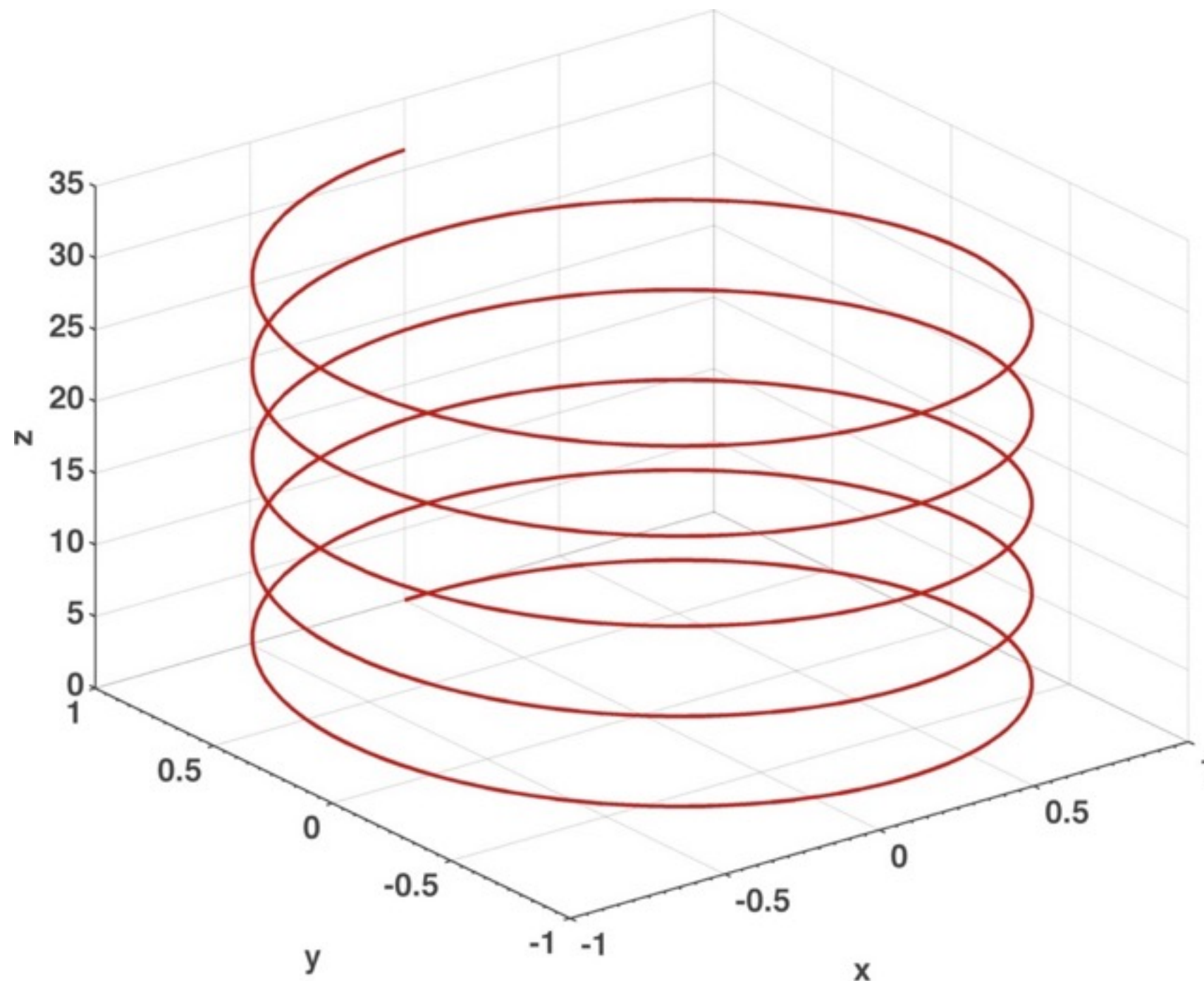- Syntax: surf(x,y,z) and mesh(x,y,z) are used to visualize a surface in three dimensions

plot3

- Syntax: plot3(x,y,z) plot points in 3D

Demo:
Plot Types

http://www.mathworks.com/help/matlab/2-and-3d-plots.html

subplots

- the 'subplot' command let's you plot multiple plots on one figure
- syntax: subplot(nRows, nCols, index)

(Figure 1)

subplot(1,3,1)   subplot(1,3,2)   subplot(1,3,3)

subplots

- the 'subplot' command let's you plot multiple plots on one figure
- syntax: subplot(nRows, nCols, index)

(Figure 2)

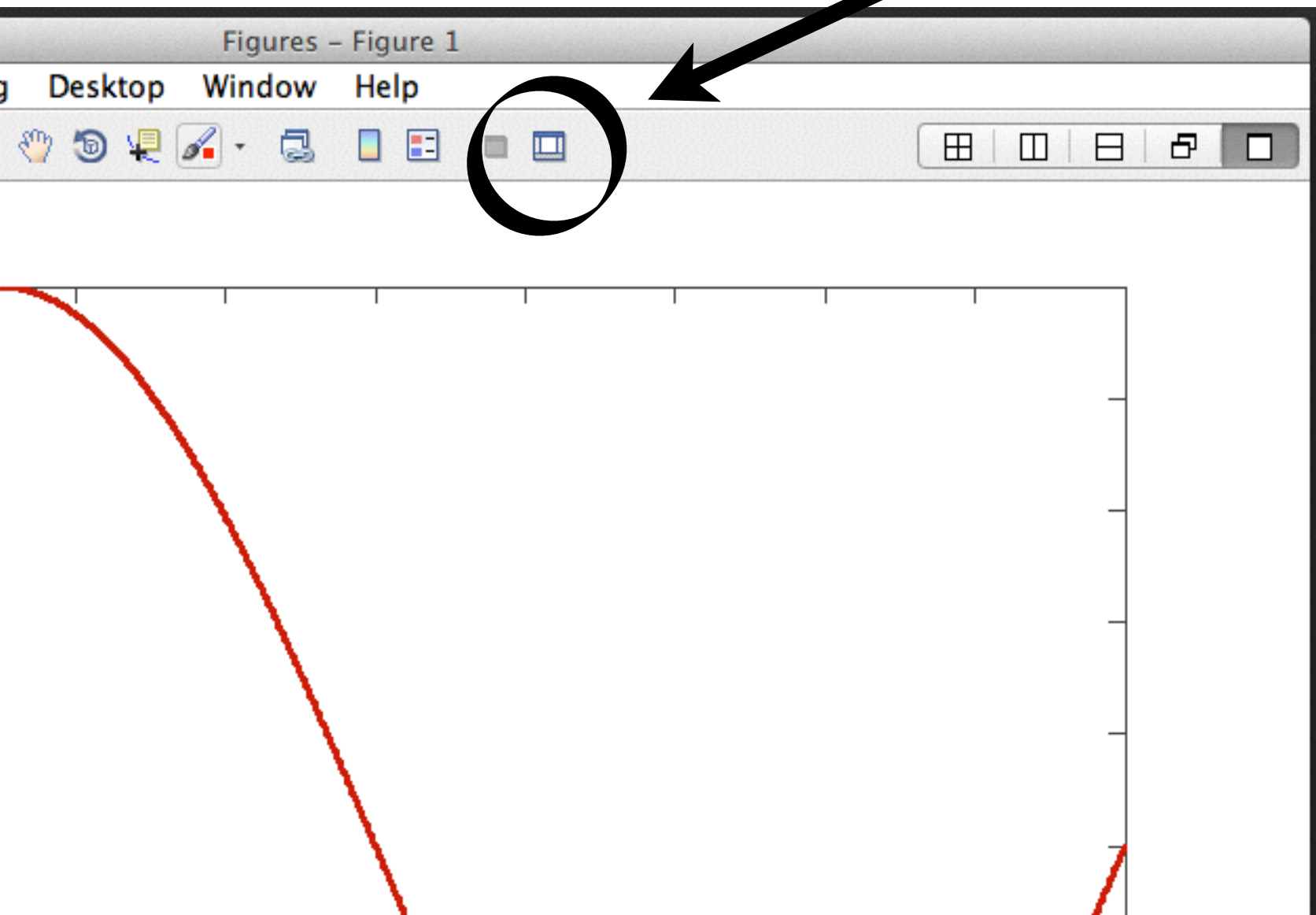|	
subplot(3,2,1)	subplot(3,2,2)
subplot(3,2,3)	subplot(3,2,4)
subplot(3,2,5)	subplot(3,2,6)

Demo: Subplots

Customizing Graphs Graphically

Plot Tools

Demo: Customizing Graphically

Color in Matlab

Matlab has 8 built-in colors:

    Black (k), Red (r), Blue (b), Green (g),

    Cyan (c), Magenta (m), Yellow (y), White (w)

We can specify other colors using RGB (red, green blue) notation:

blue = [0 0 1]

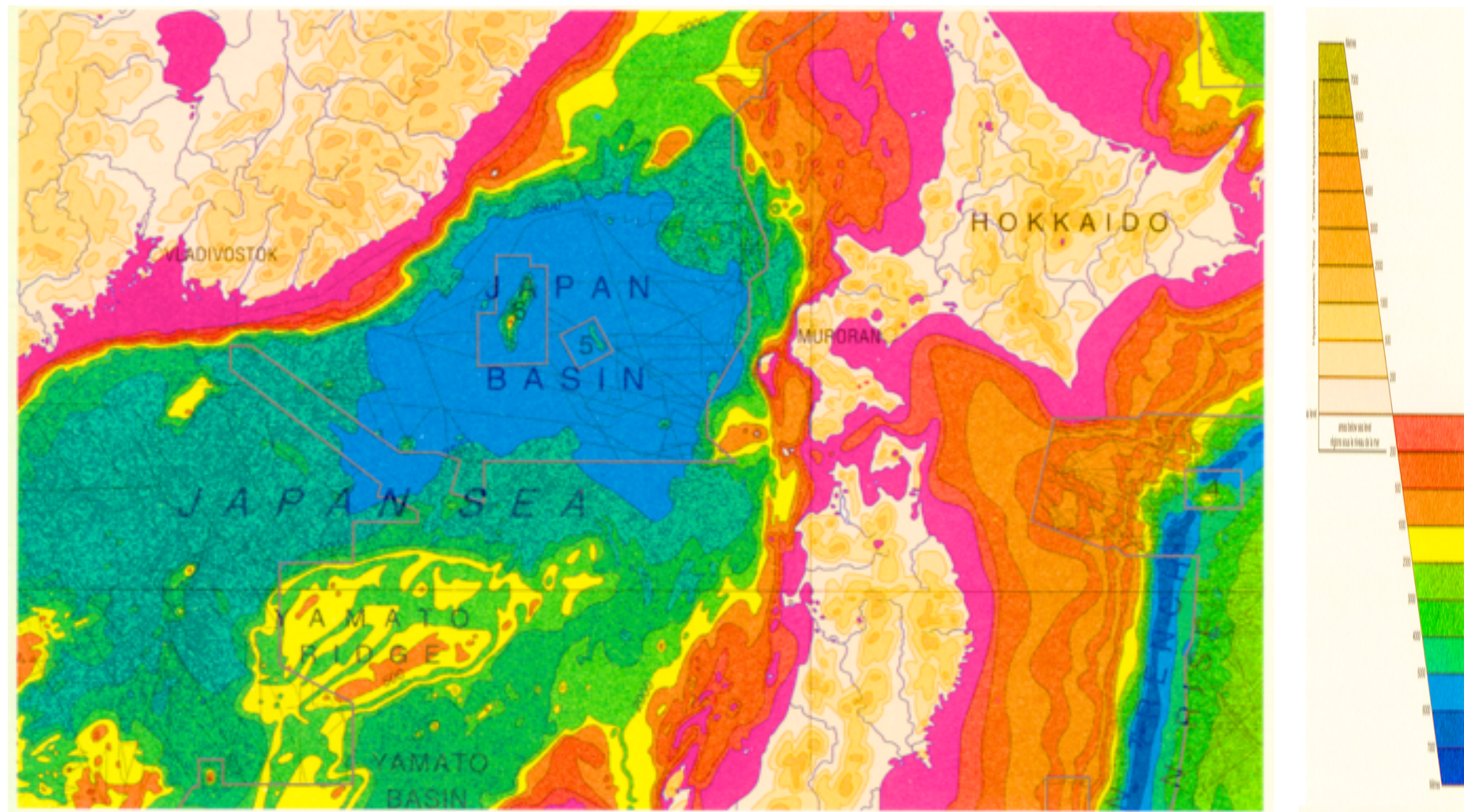green = [0 1 0]

gray = [0.2 0.2 0.2]

Colormaps

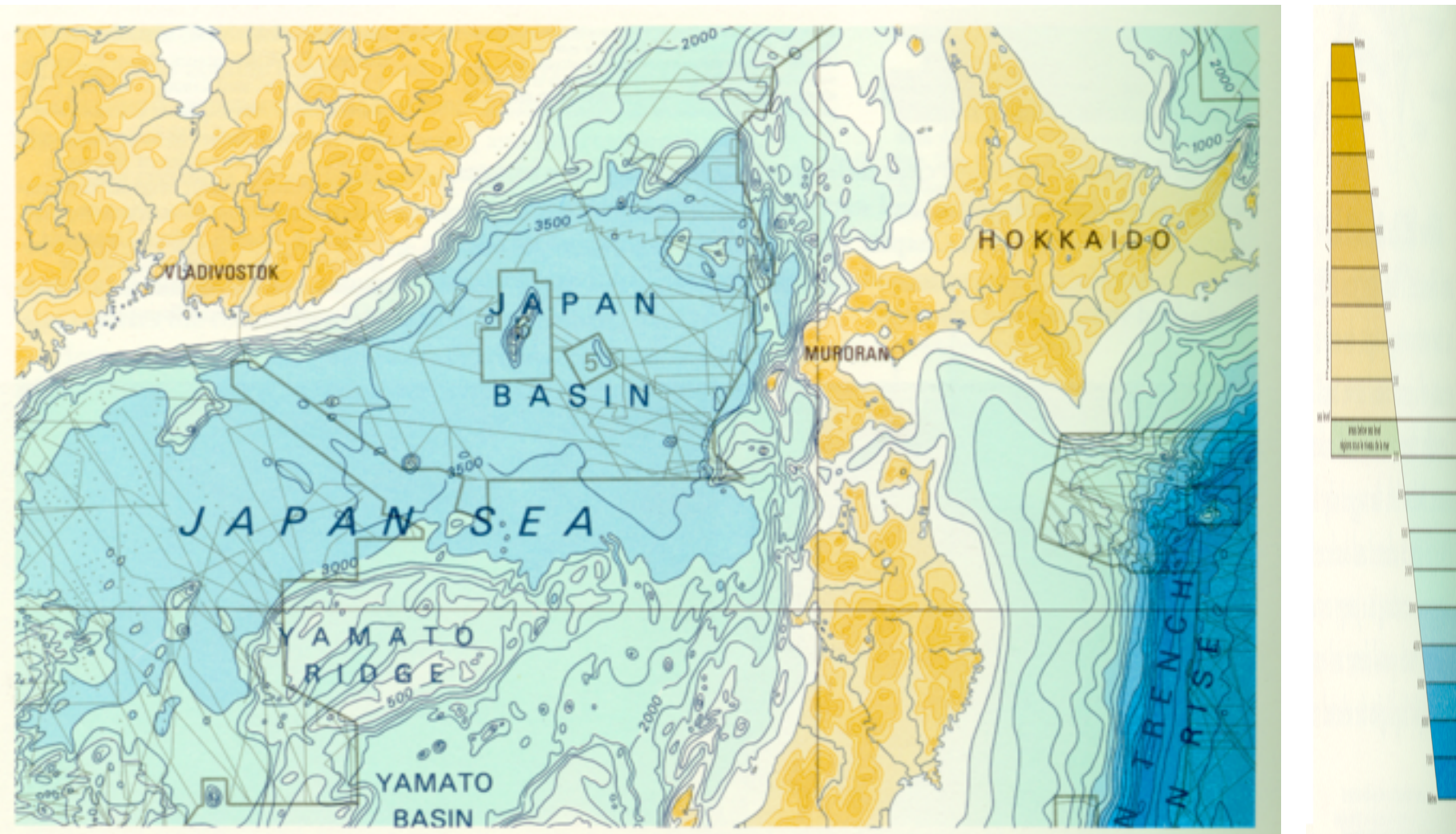Colormaps are used to specify how data gets mapped onto different colors.

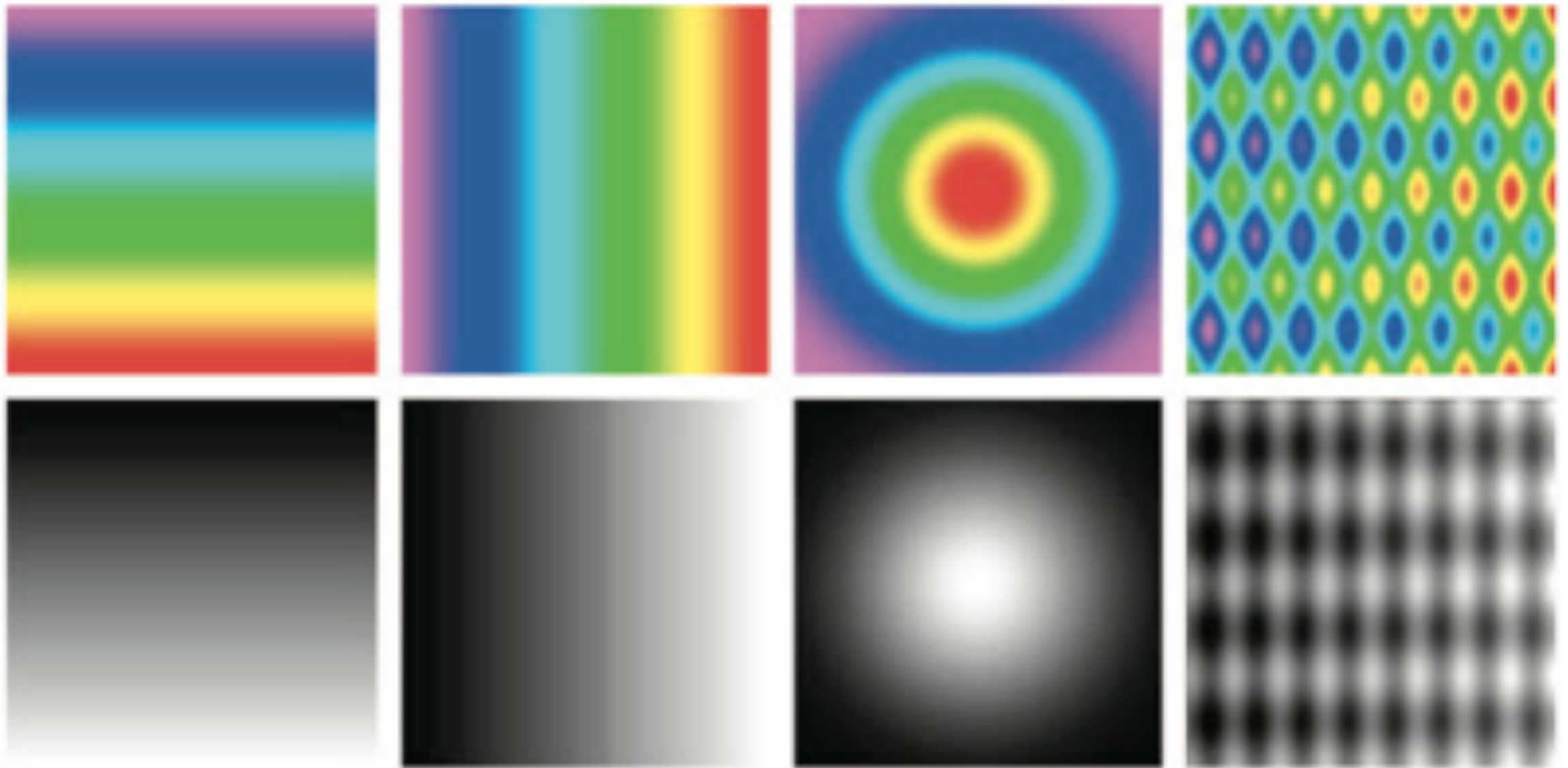Matlab has a few built-in colormaps, but you can also specify your own!

Why are colormaps important?

Much better!

Avoid the default colormap (jet)

Demo: Color

Figure formats

Matlab saves figures using it's own **.fig** format.

If we want to share our figures with others, or put them in a paper, we will export to other formats, including:

JPG, **PNG**, **EPS**, **PDF**, **TIFF**

Bitmap vs. Vector graphics

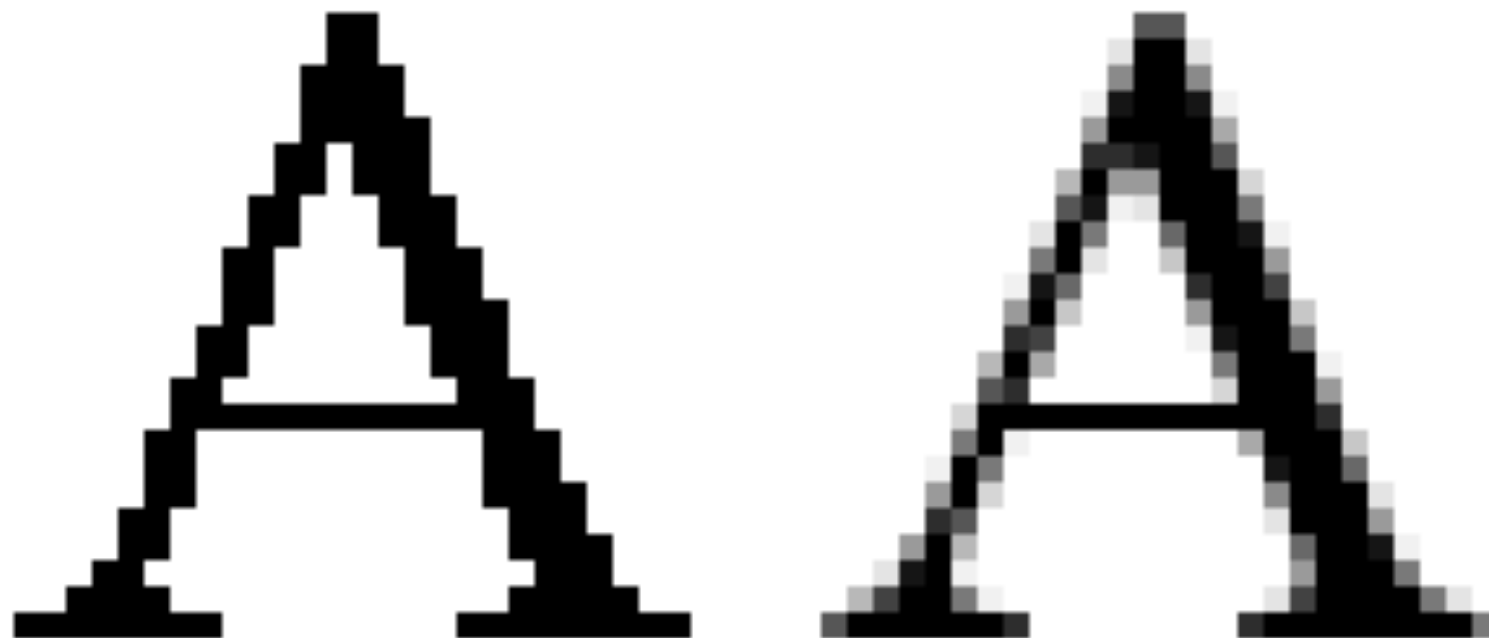Two main classes of image formats: **bitmap** vs. **vector** graphics

Bitmap (jpg, png):
- Fixed image sizes
- Best for actual images (pictures of stuff)

Vector (eps):
- Variable image sizes
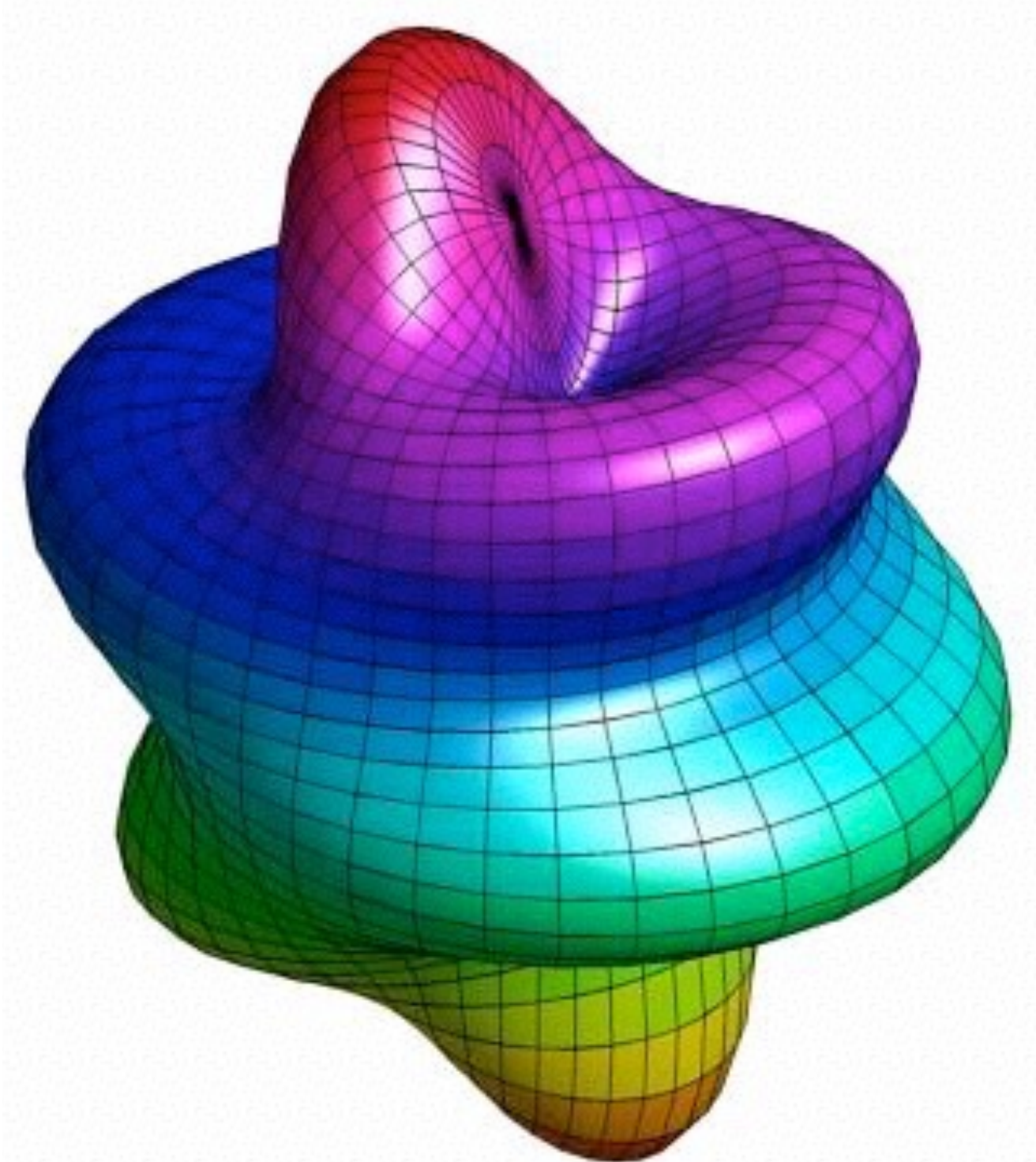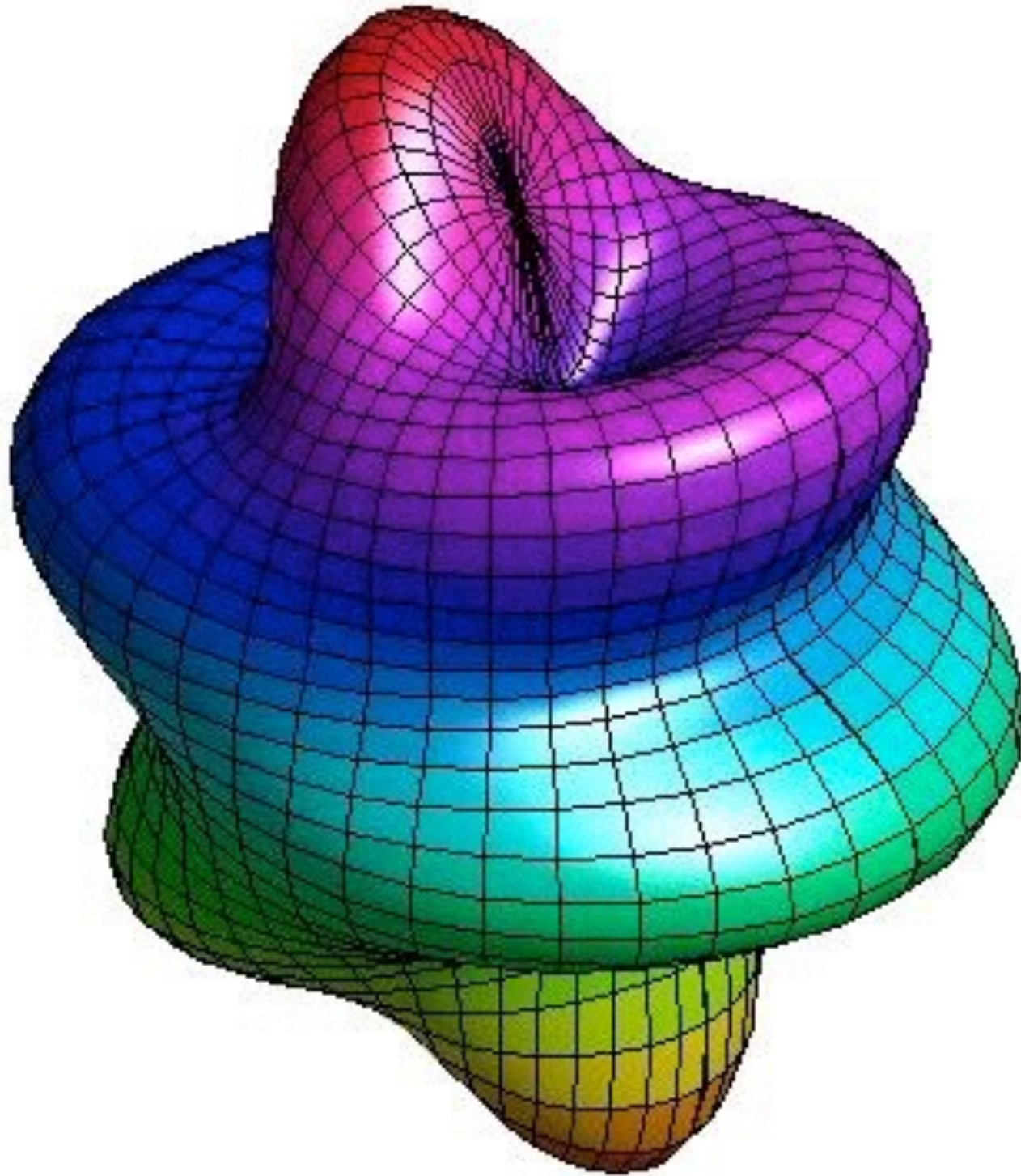- Best for line / bar graphs, scatter plots, etc.

Aliasing

Left: Aliasing occurs due to finite pixel resolution.

Right: We deal with it by using an anti-aliasing filter

Aliasing

Demo: Exporting Figures

Figure handling

Figures in Matlab are referenced using "handles", which are pointers to different parts of the figure.
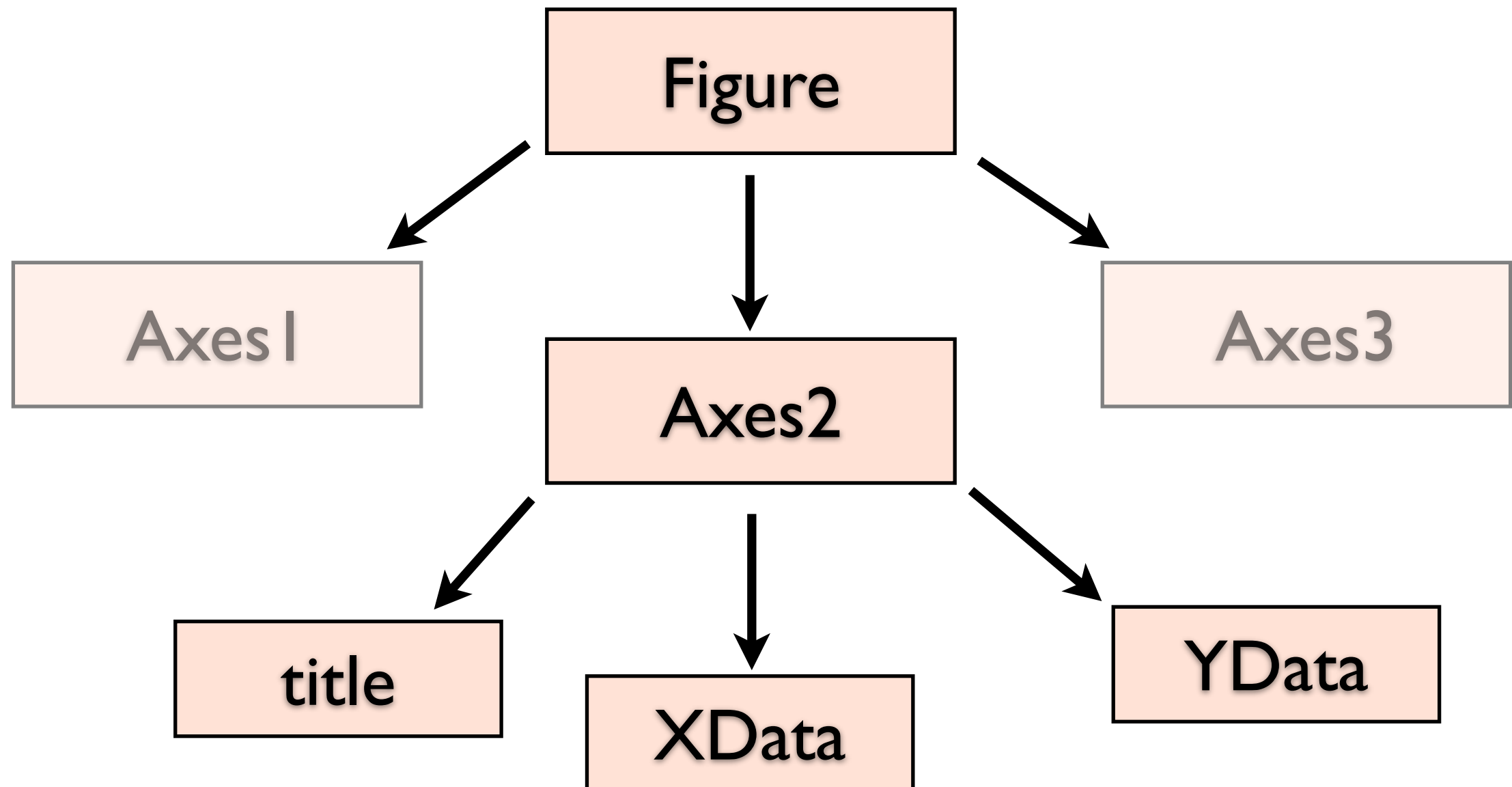
Example:

```
myhandle = plot(x,y);
```

Will return a handle to the plot. Then you can run the following:

```
get(myhandle); % to see a list of properties
set(myhandle,'Name',Value); % to set the value of a property
```

Figure handling

Different parts of the figure are organized hierarchically:

Demo:
Customizing
Programmatically

Demo:
Annotating plots

Other Resources

2D and 3D visualization examples:
http://www.mathworks.com/help/matlab/2-and-3d-plots.html
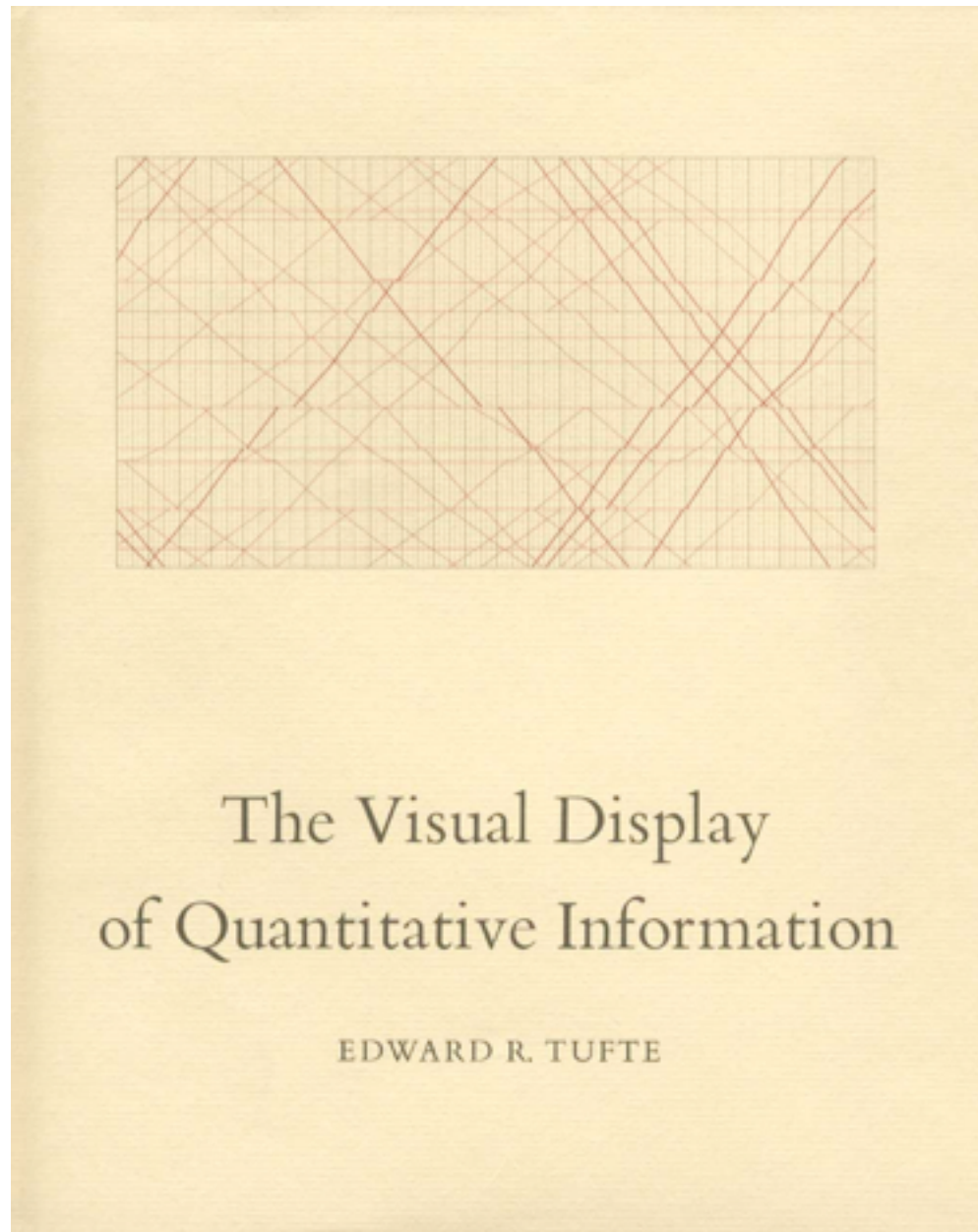
Custom colormaps:
http://colorbrewer.org

Anti-aliasing filter:
http://www.mathworks.com/matlabcentral/fileexchange/20979-myaa-my-anti-alias-for-matlab

Colors in figures (blog post)
http://figuredesign.blogspot.com/2012/04/meeting-recap-colors-in-figures.html

Other Resources

<- Book by Edward Tufte

Lots of principles / guidelines
for making good figures