Computing for Math and Stats

Lecture 18

3-D Surfaces

- To plot a surface we have to
  - Create the 2-D structure
  - Map the 2-D structure to 3-D
- We can plot with
  - Mesh
  - Surf
  - Surfc, meshc (with contours under it)
  - Surfl (with lighting)
  - Waterfall
  - Contour, contour3
  - Stem, scatter3 (stem plots the stems as well)
  - Bar3, pie3

2-D Surface Creation

- To create a 2-D surface we either
  - Use meshgrid (to plot Z(X,Y)) like gaus3D.m
  - Make a custom surface (to plot [X(uv),Y(uv),Z(uv)])
    - sphere3.m
- Mapping it to 3-D is easy
  - If we know geometry
  - See donut.m, twistdonut.m

Ploting Ellipses

- We can plot a sphere to start with
- Then before we plot we multiply with a 3x3 matrix
- This stretches the sphere in some direction
- Ellipses can be represented by 3x3 symmetric positive definite matrices
  - If you do not know what this is, do not worry, you will learn in Linear Algebra

Matrices and ellipses

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1 \qquad \begin{bmatrix} x \\ y \end{bmatrix}^T \begin{bmatrix} a^2 & 0 \\ 0 & b^2 \end{bmatrix}^{-1} \begin{bmatrix} x \\ y \end{bmatrix}=1$$

$$\begin{bmatrix} x \\ y \end{bmatrix}^T M^{-1} \begin{bmatrix} x \\ y \end{bmatrix}=1 \qquad \begin{bmatrix} x \\ y \\ z \end{bmatrix}^T M^{-1} \begin{bmatrix} x \\ y \\ z \end{bmatrix}=1$$

Ellipses and Gaussian Data

- Data that follow the Gaussian distribution are inside (mostly) a 3-D ellipsoid
- This ellipsoid is about 3 times as big as the one represented by the Variance Covariance Matrix
  - The variance covariance matrix is what is returned by the cov function in Matlab.
- See covellipse.m, gellipse.m