

# 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
  - Surf, meshc (with contours under it)
  - Surf (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

# Plotting Ellipses

- We can plot a sphere to start with
- Then before we plot we multiply with a 3x3 matrix
- This stretches the circle 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

# 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`