

# Computing for Math and Stats

## Lecture 17

# A Note about Least Squares

- Most (simple) implementations of least squares involve the operation  $A^T A$
- This can be blamed for numerical instabilities (large effects of round-off error)
  - Multiplying two large numbers gives an even larger number, multiplying small numbers gives an even smaller number, so when adding the two the round off swallows the small number (roughly speaking)
- There are methods that avoid the problem
  - Most often they involve QR factorization or SVD
- When applied to large problems (many unknowns) indirect (or iterative) methods are used.

# Interpolation

- A common use for polynomial fitting
- Matlab provides function `interp1` for 1-D interpolation
- Given the value of a function on distinct points find the value of the function in between
- There are many ways to do it
  - Nearest
  - Linear
  - Cubic (spline, Hermite)

# Interpolation

- Nearest: fitting a zero degree polynomial (constant) around the nearest point.
- Linear: fitting a first degree polynomial (line) on the two neighboring points
- Spline: fitting cubic splines
- Pchip: piecewise cubic Hermitian interpolation (similar to cubic, but without the peculiar swings and overshootings)
- See `interpex.m`, `myinterp1n.m`, `myinterp1l.m`, `myinterp1n2.m`, `myinterp1l2.m`

# 3D Plots

- Matlab has several mechanisms to display 3-D plots
  - Plot3 draws 3-D lines
  - Mesh surfaces as a wiremesh
  - Surf draws colored surfaces
- They are utilities to create plots
- Easy to use if you are mathematically minded

# 3D Plots

- Plot3d: how to
  - Create 3 matrices  $X, Y, Z$  that represent the 3D points of a space curve
  - Call plot3d
- Mesh and Surf
  - The mesh points are on a surface. Point  $i, j$  of the surface has coordinates  $X(i, j), Y(i, j), Z(i, j)$
  - One has to create these three matrices ( $X, Y, Z$ ) to plot a mesh or surface.
- See gaus3D.m donut.m

# Things to try at home

- Play with the two versions of mypolyfit and create several different datasets to fit polynomials. Find which version works on most datasets.
- Modify the code of mypolyfit to print out or return a measure of the error in the fit. There are two kinds of errors that might be of interest. Can you think what they are?