Technical Computing for the Earth Sciences, Lecture 2:

Solving some linear inverse problems for the Earth sciences

EARS 80.03

Linear inverse problems

You're already solving a linear inverse problem: Project 1!

- All the detailed matrix math is there, so I won't repeat it here, just a few really general concepts instead..

Linear inverse problems

Generalized linear inverse problem: you have

- some data y

- an equation of the form $y =$

  $$a*(something) + b*(something\ else) + c*(something\ else\ else) + \ldots$$

(where each *something* is a different function of x)

and you want to invert for a, b, c, …

Or in matrix form: $y = A * \phi$ where $\phi = [a, b, c, ...]$

What's the difference between *linear* and *nonlinear* inverse

problems??

Linear inverse problems

Invert for constants a through **....** Linear or nonlinear inverse problem?

$$y =$$

1) $$a + b * x + c * x^2 + d * x^3 + \ldots$$

2) $$a + b * x + c * x^2 + d * x^3 + e * sin(x) + f * log(x)$$

3) $$a + b * x + c * x^2 + d * x^3 + e * sin(x/g) + f * log(h * x)$$

4) $$a + b * x^c$$

Linear inverse problems

Invert for constants a through **....** Linear or nonlinear inverse problem?

$$y =$$

1) $$a + b*x + c*x^2 + d*x^3 + \ldots \quad ✅$$

2) $$a + b*x + c*x^2 + d*x^3 + e*sin(x) + f*log(x) \quad ✅$$

3) $$a + b*x + c*x^2 + d*x^3 + e*sin(x/g) + f*log(h*x) \quad ❌$$

4) $$a + b*x^c \quad ❌$$