#### **Effective Programming Practices for Economists**

### **Numerical Optimization**

**Choosing optimization algorithms** 

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# Steps for choosing an algorithm

- 1. Theory (intro here)
- 2. Experimentation (histories video)
- 3. Refine until convergence

### Relevant problem properties

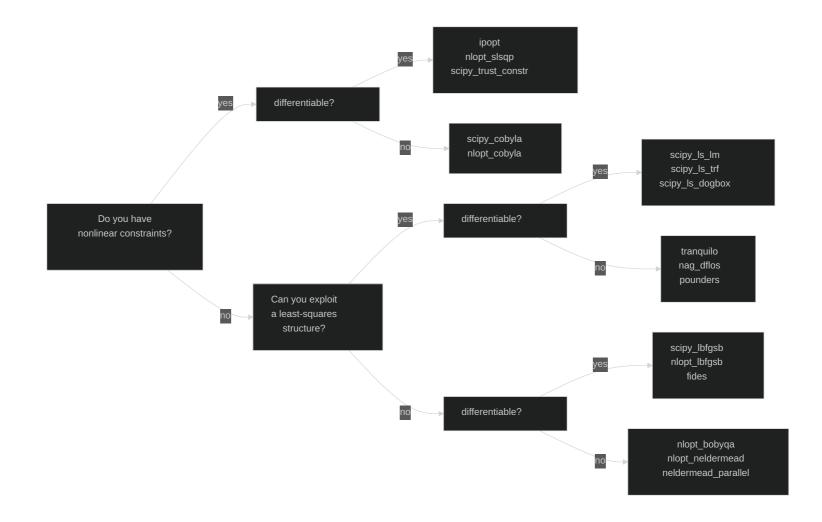
- Smoothness: Differentiable? Kinks? Discontinuities? Stochastic?
- Convexity: Are there local optima?
- Goal: If not convex, do you need a global solution? How precise does a solution need to be?
- Size: 2 parameters? 10? 100? 1,000? Millions? Billions?
- Constraints: Bounds? Linear constraints? Nonlinear constraints?
- **Structure**: Nonlinear least-squares, Log-likelihood function
- $\rightarrow$  Properties guide selection but experimentation is important
- $\rightarrow$  Always compare multiple algorithms in a criterion plot

## Try to make your problem simpler

- Get derivatives using automatic differentiation (JAX, pytorch)
- Make your function faster
- Make your function more stable
- Make your function smooth

# **Choosing local optimizers**

Next slide has a practical guide, see optimagic docs for more details.



### Choosing a global approach



Always refine the result of a global optimizer with a local one