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

## **Scientific Computing**

#### **Choosing optimization algorithms**

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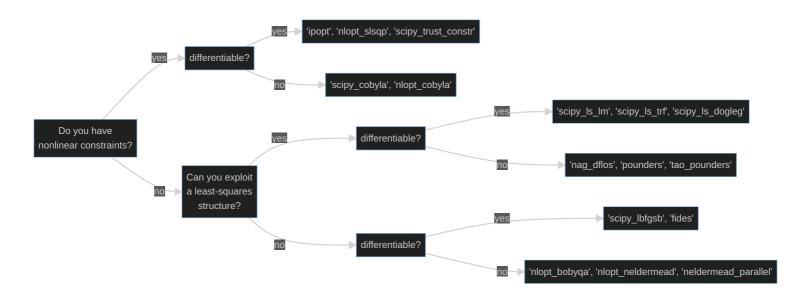
### Relevant problem properties

- **Smoothness**: Differentiable? Kinks? Discontinuities? Stochastic?
- Convexity: Are there local optima?
- Goal: Do you need a global solution? How precise?
- **Size**: 2 parameters? 10? 100? 1000? More?
- 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

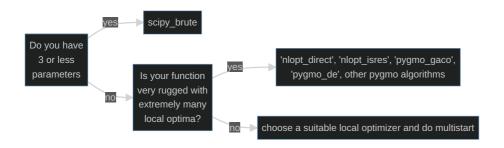
# Try to make your problem simpler

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

### **Choosing local optimizers**



#### Choosing a global approach



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