Notes on Computational Methods in Economics

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ECON 602: Advanced Macroeconomics Theory and Policy
Outline

1. Computational Methods in Economics: General Points
2. Rules of Thumb for Doing Good Computational Work in Economics
Three modes of science: theoretical, computational, empirical. Computational work shares elements of both theoretical and empirical work.

Two meanings of computational economics: computation as a tool for doing standard economic theory vs. computation as a model for how economic actors behave.

Fundamental shortcoming of the first kind of computational economics: lack of error bounds. How far apart are the computational model and the theoretical model?
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Computation produces “data” which can be used to generate theoretical conjectures. These conjectures could be exact (theorems) or approximate (systematic patterns).

- Use computation to measure quantitative magnitudes (e.g., the relative sizes of opposing effects).
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1. Start with the simplest possible model, preferably one with an analytical solution.
2. Add features incrementally.
3. Never add another feature until you are confident of your current results.
4. Use the simplest possible methods.
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6. Use methods that are as transparent as possible (i.e., methods for which the computer code reflects as closely as possible the economic structure of the problem).

7. When you learn (or develop) a new method, test it on the simplest possible problem, preferably one with an analytical solution.

8. Dan Bernhardt’s rule: If you have $n$ errors in a piece of code and you remove one, you still have $n$ errors. Scrutinize your results, even if they look right. Look for anomalies. Assume your code is wrong until proven otherwise.

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Be able to replicate all of your intermediate and final results instantly. Save exact copies of the code used for each run, together with inputs and outputs.

Watch the computations as they proceed.

Exploit homotopy.

Learn a fast language, such as C or Fortran.

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Get good initial conditions.

Use one-dimensional algorithms as much as possible.

Use algorithms that can be “tightened”.

Avoid black boxes. Understanding how the algorithm works is critical to interpreting the results.

Remember that programming is a creative activity analogous to writing a sonnet or composing a sonata (a static, visual representation of a process). Craft your programs. Strive for efficiency and elegance in your computer code. Develop a style. Practice structured programming, i.e., write code that reflects the structure of the algorithm.

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