Reduced Models, Sensitivity, and Inverse Problems

Bob Eisenberg

March 2, 2012

'Recommended' Comment on Paul Krugman Blog

http://krugman.blogs.nytimes.com/2012/03/02/the-microfoundation-thing-wonkish/#postComment

Dear Prof. Krugman,

Your simplified models are an example of the reduced models used throughout science. The most striking examples are in engineering, where reduced models of devices are the center, even fulcrum, of analysis. No one tries to analyze an amplifier from its circuit diagram. Everyone simply uses the "gain equation". Physiologists have used the same approach for a very long time, before engineering existed. Simple 'laws' are used to describe blood flow, urine production, etc. These have been taught and used by every physician 'forever'.

From a math point of view, the crucial insight, in my opinion, comes from the theory of inverse problems, or reverse engineering, where the sensitivity function is always computed along with the "transfer function" (e.g., gain). The sensitivity function tells you when you have a reliable reduced model. For an amplifier, the sensitivity of the gain (the derivative) with respect to input and output is essentially zero (for a good amplifier). BUT the sensitivity of the output to the input is 100%, because the output is proportional to the input.

You get the idea.

Has the theory of inverse problems been used in mathematical economics to evaluate the reliability of analytic models?

Ever yours

Bob Eisenberg
Bard Endowed Professor and Chair
Dept of Molecular Biophysics
Rush University Chicago

See

1) Engl et al Regularization of Inverse Problems

2) Kaipio & Somersalo, Statistical & Computational Inverse Problems

March 2, 2012 at 10:33 a.m.