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Computational Economics

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Abstract-- The recent advances in modeling tools have greatly expanded the possibility set for economists. This has led to the rapid emergence of computational economics as an independent branch in economics. Computational economics is a multidisciplinary field that explores the interaction of economics and computational systems. It has added a new dimension to microelectronics. This paper provides a brief introduction to computational economics.

Keywords Computational economics, agent-based computational economics

I. Introduction

The increasing power of computers has given the economic scientists new opportunities and vast potential. As far as computation is concerned, economics is undergoing the same transformation as physics, chemistry, social science, sociology, biology, and other hard sciences.

Computational economics (CE) is a marriage between computer science and traditional economics. In a sense, CE is a new programming methodology. CE solves problems that are difficult to study without the use of computers. For example, computational tools include software for carrying out various matrix operations and for solving systems of linear and nonlinear equations. Computational techniques have successfully been applied to solve problems in these areas.

A newly emerging branch of CE has come to be known as agent-based computational economics (ACE), the computational study of economies modeled as evolving systems of autonomous interacting agents. ACE allows us to model complex sets of relationships that cannot be explicitly modelled using traditional approaches. It is the computational study of economies modeled as evolving systems of autonomous interacting agents with learning capabilities. The economic agents can include consumers, producers, intermediaries, etc. ACE assume that agents are heterogeneous and rational and that they interact with each other. It offers possibility of modeling agents that learn and adapt to their environment [1].

Students working on CE acquire model development skills. These skills are the ability to conceptualize the science, engineering and economics of a problem and to convert that understanding first to a mathematical model and then to a computational representation in a software system [2].

II. Applications

Although the tools and approaches may differ, the agendas of traditional economics and CE are complementary. CE modeling is a complement, not a substitute, for analytical modeling approaches. The CE approach to economic problems is novel. It exploits new powerful computational tools, most notably object-oriented programming. These tools permit CE researchers to extend previous work on economic self-organization and evolution.

The application of CE addresses two key questions: whether a particular CE problem is solvable in principle and whether it is solvable in practice. Computational economics has been powerfully applied to a number of economic systems, and the most successful and attractive one is probably the agent-based financial market. They have been used to handle economic problems such as cyclical growth, monopolist´ searching, adaptively learning duopoly, multiplier-accelerator dynamics based on the different behavior of investor, etc. using appropriate software such as MATLAB-SIMULINK, STELLA, VENSIM, SWARM, GEMODEL, NetLogo, Mathematica, and EXCEL [3].

CE tools have also been applied to forecast financial time series, estimate econometric parameters, model trade processes, replicate laboratory results with human subjects, simulate artificial stock markets and social processes, design public policies, simulation of policy options, world-wide models of some industries, etc. [4,5].

One of the areas in economics that requires high computing power is macroeconometric modelling with forward-looking variables because it involves very large systems of equations. Multicore processors, GPU computing, MPI clusters have become available to economists for solving large problems that require high performance computing [6].

III. Challenges

It has been difficult for computational economics to gain acceptance as a tool for the analysis of economic models. There is little agreement on how to present computational results. There is no common core of methods. The combination of poor scholarship, poor grasp of basic computational methods, and sloppy standards combine to make computational economics look bad in the eyes of those aware of the problems [7]. CE requires interdisciplinary collaboration, but communication across disciplinary lines can be difficult.

Attempts by researchers to conduct parallel experiments with real and computational agents has raised a number of challenging issues. One challenge is that experiments run with human participants generally have to be kept short to avoid boredom among the participants [8].

V. Conclusion

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Computational economics is a means solving economic problems with the help of computing tools. The new directions in supercomputing are beneficial to computational economics. We are approaching an era where computing tools are sufficiently advanced and user-friendly that one does not have to be a specialist to use them effectively.

The field of CE is growing steadily, as evidenced by specific societies, journals, workgroups, and courses (even an M.Sc. degree) [9]. The need for computational economics courses in undergraduate graduate programs is becoming increasingly apparent to economists.

For more information on computational economics, consult *Computational Economics* (the official journal of the Society for Computational Economics that came into being in 1994), the *Journal of Economic Dynamics and Control (JEDC), ACM Transactions on Economics and Computation,* and *International Journal of Computational Economics and Econometrics.* These are internationally competitive, peer-reviewed journals dedicated to research on CE. There are also several books on CE which may be found in Amazon.com.

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