Dr. B.R. Ambedkar
School of Economics
University
Bengaluru

A Unitary University, Govt. of Karnataka

anvikshan
THE RESEARCH SOCIETY

One Day National Workshop

FROM SYSTEM OF EQUATIONS TO NETWORK OF AGENTS

ROB AXTELL

GEORGE MASON UNIVERSITY &
SANTA- FE INSTITUTE

ANTOINE MANDEL
PARIS SCHOOL OF ECONOMICS

PAWAN G
RESERVE BANK OF INDIA

SOHAM B
DR. B. R. AMBEDKAR SCHOOL OF ECONOMICS UNIVESITY, BENGALURU

VIPIN VEETIL
IIM KOZHIKODE

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DATE

18TH NOVEMBER 2023

VENUE

Dr. B. R. Ambedkar School of Economics
University, Bengaluru

Dr B R Ambedkar School of Economics University

Invites you to a One-Day National Workshop on

From System of Equations to Networks of Agents

Date: 18th November 2023.

Workshop Flyer and Schedule

Spot Registration and Online Registration Verification: 08:00 IST

09:00 AM, IST: Welcome Address: Prof. N R Bhanumurthy, Hon'ble Vice Chancellor at the Dr B R Ambedkar School of Economics University.

09:15 AM IST: Speech from the Hon'ble Registrar: Vidhyashree Chandaragi (Karnataka Administrative Services): *Vision of University at the Dr B R Ambedkar School of Economics University, Bengaluru.*

Keynote Speech (Online, Time to be decided)

Keynote Speaker: Prof. Robert Axtell, George Mason University and Santa-Fe Institute

Keynote Title: "Economic Theory at a Crossroads: From Data-Poor to Data-Rich Theories"

Abstract of Keynote: The mathematical formulation of economic theory, begun in the 19th C and progressively elaborated over the course of the 20th C, occurred against the backdrop of extremely limited, low frequency, highly aggregate data. It is not that micro-data did not exist in these eras, rather that it was administratively- and computationally-expensive to collect and access, requiring large amounts of manual labor. This situation began to change materially at the start of the new millennium, with IT systems providing systematic access to entire universes of administrative data, as well as the advent of large-scale field trials. When data were limited, the framing of economic theory in terms of a modest number of equations that could be solved numerically made sense. But with the deluge of micro-data over the past 20 years there is little reason to aggregate it, especially when, increasingly, economists care about distributional questions and equity issues. Therefore, there is declining value in writing down equations to be solved. In this talk I will illustrate these ideas by describing and demonstrating a large-scale agent-based computational model of the entire U.S. private sector in which, essentially, no equations are solved, but in which 100s of millions of purposive agents seek utility gains over time, through productive work in multi-agent teams. I will conclude by arguing that data-rich economics of the future will look more like computing with agents than solving systems of equations.

Workshop Session I: 11:00 IST- 12:00 IST (Tentatively)

Title: ***General Equilibrium in Economics: Bridging 'Micro' to 'Macro' problems***

Speaker: **Soham Bhattacharya**, Assistant Professor, B R Ambedkar School of Economics University

Concept Note: The textbook concepts of general equilibrium in microeconomic theory often gets blurred due to the '*mathiness'* associated with exchange, production, and welfare. This problem is confounded by the fact that the journey from Marshallian partial market analysis to Walrasian system of equations entails certain crucial assumptions that often go unappreciated. This session will delve into the history of general equilibrium (GE) theory by carefully analysing the fundamental assumptions associated with GE models. We shall then delve into what these micro-GE assumptions mean for macroeconomic dynamics. We will also build a bridge between GE and Leontief's input-output analysis, a Kuznets' transformation, and a Lewisian structural transformation. The purpose of this session to nurture a deep understanding of the core concepts involved in GE and its connections to macroeconomic theorizing.

Reading (s): *Roncaglia, Alessandro, 2005: 'General Equilibrium in Economic Theory', Chapter from The Wealth of Ideas. For a more formal definition and derived results using Euclidean N-dimensional Space, See: Balasko, Y. 1986. Foundations of the Theory of General Equilibrium. New York: Academic Press. For a critical take on GE, read Samuel P Bowles (1991): Microeconomics.*

Workshop Session II: 12:15 IST - 13:30 IST

Title: ***"What if things become 'Uncertain'? Introducing 'Stochastic' and 'Dynamic' in the General Equilibrium Theory"***

Speaker: **Pawan Gopalakrishnan** , Assistant General Manager, Strategic Research Unit, Reserve Bank of India.

Concept Note: Dynamic Stochastic General Equilibrium (DSGE) models are in some senses the workhorses of macroeconomic analysis. This session will delve into why "Dynamic" and "Stochastic" components had to be introduced into GE for macroeconomic analysis. The session will also present a brief history of the micro-foundations of macro debates, and the outlook of the New Keynesian and New Classicals schools in their use of DSGE models. The session will further touch upon how Bayesian stochastic processes are used with DSGE setting to model the expectation formation process of economic actors.

LUNCH BREAK: 13:30 IST -14:15 IST

Workshop Session III (Online): 14:30 IST- 15:45 IST

Title: ***The Mathematical Evolution from System of Equations to Network of Agents***

Speaker: **Antoine Mandel**, Professor, Paris School of Economics.

Concept Note: Introduction and emphasis to the system of equations during the Walras-Pareto era of understanding a 'general equilibrium' was induced by the pre-Hilbert era of non-axiomatic mathematical philosophy. It is with Arrow-Debreu systems the mathematics of general equilibrium gets strongly influenced by the axiomatic approach. This session will start from this departure and eventually introduce the concepts of stochastic uncertainty and how 'Bayes' and 'Markov' becomes part of the general discourse of economics. This session will aim to conclude by introducing the mathematical departure that agent-based models have brought to the system of equations. Here is where we get the network of agents and the 'new mathematics' for social sciences.

Workshop Session IV: 16:00 IST- 17:15 IST

Title: ***Modelling Non-equilibrium and Disequilibrium Macroeconomic Dynamics with Agent-based Models***

Speaker: **Vipin P Veetil**, Assistant Professor, Indian Institute of Management Kozhikode.

Concept Note: Much of mainstream economic theory is built on the idea that the world outside the window is perennially in equilibrium, or at the very least sufficiently close to it. This belief in equilibrium though widely used is not universally accepted among economists. Some economists believe that a wide variety of phenomena in the real world are a consequence of disequilibrium dynamics, wherein a system is said to be in 'disequilibrium' if it has a tendency to change its present state even in the absence of an external force. There are even economists who believe that the economic system has no tendency to go towards any well-defined equilibrium, i.e. much of the world outside the window exhibits non-equilibrium dynamics. Agent-based models are useful to study the behavior of systems that exhibit disequilibrium and non-equilibrium dynamics. Agent-based models are essentially synthetic economies in silico populated with firms, traders, and other economic decision makers. Economic agents in such systems may make decisions using complicated algorithms or simple rules. Put differently, agent-based models can be used to study the macro consequences of various micro specifications about behaviors, interactions, and information sets. Agent-based models are studied by running them forward in time and analysing the data generated by the model. Agent-based models are useful to study phenomena which are very difficult to describe using equations. Such models are typically built using object-oriented programming languages to take advantage of the "encapsulation": a programming paradigm that carries over well with the economics of decision-making with limited information. Over the last two decades, agent-based models have emerged as an alternative to equation-based models, almost as if they were a new mathematics for economics. This session will deliberate on the

Reading(s): "Why agents" by Robert Axtell.

Concluding Remarks: Vote of Thanks by Research Society Coordinators

SPEAKER'S BIO

Robert Axtell

Rob Axtell works at the intersection of economics, behavioral game theory, and multi-agent systems computer science. His most recent research attempts to emerge a macroeconomy from tens of millions of interacting agents. He is Department Chair of the Department of Computational Social Science at George Mason University. He teaches courses on agent-based modeling, mathematical modeling, and game theory.

Antoine Mandel

Antoine Mandel is an associate professor of applied mathematics at University Paris 1 Panthéon-Sorbonne and a research fellow at the Centre d'économie de la Sorbonne. He holds a Ph.D. in applied mathematics from University Panthéon-Sorbonne and worked for two years as a postdoctoral fellow at the Potsdam Institute for Climate impact research. His work has been applied to the analysis of the European ETS market, to the assessment of green growth prospects in Europe, and to the study of innovative regions, among other topics.

Pawan Gopalakrishnan

Pawan is an economist (Assistant General Manager- Research) at the Strategic Research Unit, Reserve Bank of India. He is interested in macroeconomics and household finance. Recently,he has also started working on climate change issues in a DSGE framework.

Vipin P Veetil

Vipin works on monetary and macroeconomics. He sees the economy as a "complex adaptive system" that is capable of generating rich bottom up dynamics.Vipin received his PhD in Economics from George Mason University and did his postdoctoral work at Sorbonne University. He is currently faculty of economics at the Indian Institute of Management, Kozhikode.

Soham Bhattacharya

Soham Bhattacharya, an Assistant Professor of Economics at the Dr B R Ambedkar School of Economics University. His research interests navigate around the intricate relations of Development Economics, Labor Economics, and Agricultural Economics. He has a PhD in Development Studies from the Economic Analysis Unit at the Indian Statistical Institute, Bangalore, and the School of Development Studies at Tata Institute of Social Sciences, Mumbai.

[Click here to Register]

Important Information:

- **All participants are required to pay a Registration Fee of INR 100 to complete their registration.**
- **No Travel Allowance/Dearness Allowance/ Accommodation will be provided for the workshop participants.**
- **Certificates shall be provided to the participants after the workshop is over. Kindly follow the tentative timeline for the same.**
- **In case some participants are traveling with their own vehicle: A correspondence email will be required for parking the vehicle inside the university premises.**
- **The registration fees can be paid either online through UPI or on-spot although the former is preferred.**
    - **UPI ID for online registration: nehamahesh459@oksbi**
    - **Kindly share the screenshot of payment at 222PGF018@base.ac.in**
- **Disclaimer: ₹100 is paid to Anvikshan, the research society. University is not accountable or liable for the registration fee.**
- **Once verified, the applicant will receive a confirmation email by the organizing committee.**

Contact Person: ANVIKSHAN

- **Shreyas Singh: 205PGE045@base.ac.in | 9934224632**
- **Sukanya Rose: 232PGF027@base.ac.in | 9336086637**

Venue Location :

Dr. B. R. Ambedkar School of Economics University, Bengaluru
Jnana Bharathi Main Road, Nagarbhavi post,
Bengaluru – 560072

Directions : Click