

HOW TO DEAL WITH DEEP UNCERTAINTY IN TRAVEL MODELING

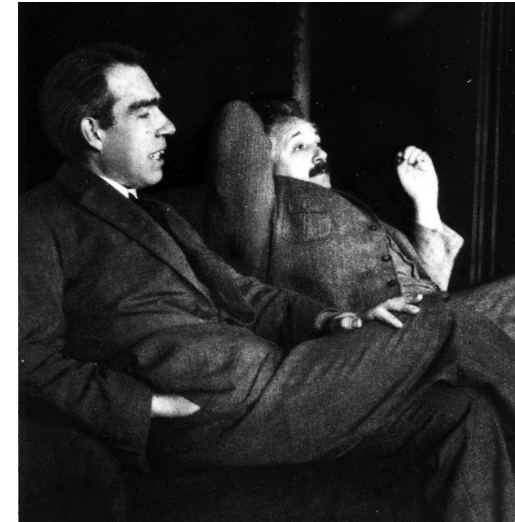
Chandra R. Bhat

The University of Texas at Austin
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LONG HISTORY IN PRACTICALLY EVERY FIELD, INCLUDING PHYSICS, MATHEMATICS AND LITERATURE*

- Albert Einstein versus Niels Bohr
 - *Einstein*: Objective and Independent Reality
 - *Bohr*: Complementarity – Overlapping descriptions that when taken together appear paradoxical and even contradictory
- Chance: Ignorance (too complex a causal system with causality, but no notion of absolute chance) versus Quantum chance (inherent nature with no causal system; chance is absolute and can never be eliminated)
- Western World (certainty, predictive power, and exercise of control) versus other societies (accept flux and uncertainty)



*From *Certainty to Uncertainty: The Story of Science and Ideas in the Twentieth Century*, by David Peat (2002)

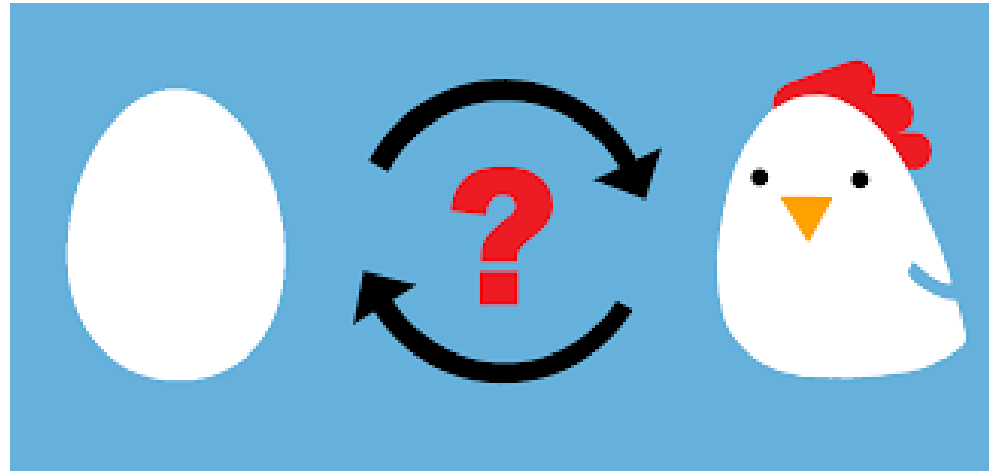
METHODOLOGY: INCLUDE BOTH CHANCE PERSPECTIVES IN MODELS

- In Traditional Single-Discrete Choice Models (that assume linear-in-consumption utility functional forms), not possible to distinguish between **Random Utility Deterministic Choice (RUDC, a la Einstein)** and **Deterministic Utility Random Choice (DURC, a la Bohr)** paradigms.
- In Multiple Discrete-Continuous (MDC) Choice Models (that assume nonlinear-in-consumption utility functional forms) with additively separable utility function, again cannot distinguish between **RUDC** and **DURC**.
- But, in Multiple Discrete-Continuous (MDC) Choice Models (that assume nonlinear-in-consumption utility functional forms) with non-additively separable utility function, can distinguish between **RUDC** and **DURC** and accommodate both paradigms within an **RURC framework***.
- Need methods that are able to accommodate *both* paradigms and get a sense of relative magnitudes.



* Bhat, C.R., M. Castro, and A.R. Pinjari (2015), "Allowing for Complementarity and Rich Substitution Patterns in Multiple Discrete-Continuous Models," *Transportation Research Part B*, Vol. 81, No. 1, pp. 59-77.

DATA: UNDERTAKE CAREFUL INVESTIGATIONS AND INFORMATION FUSION



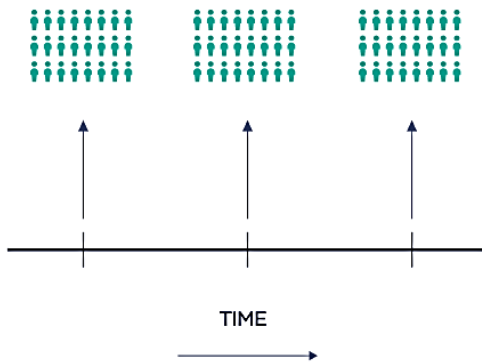
“Causality” is a latent continuous process
that is not truly observable

Causal Investigations

What may be the ideal data type for Causal Investigations?

Longitudinal Data

Collected at **multiple discrete instances**
for each respondent

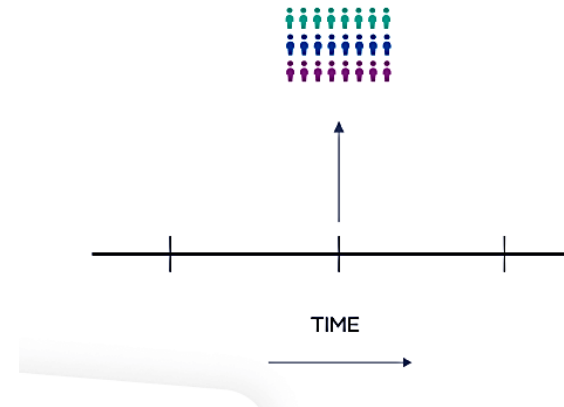


Common Issues:

- Self-selection into protracted survey process
- Drop out rates
- Fatigue effects
- High cost for repeated data collection

Cross sectional Data

Collected at **one instance** for
each respondent



Benefits:

- Lower costs
- Less fatigue
- Less self-selection

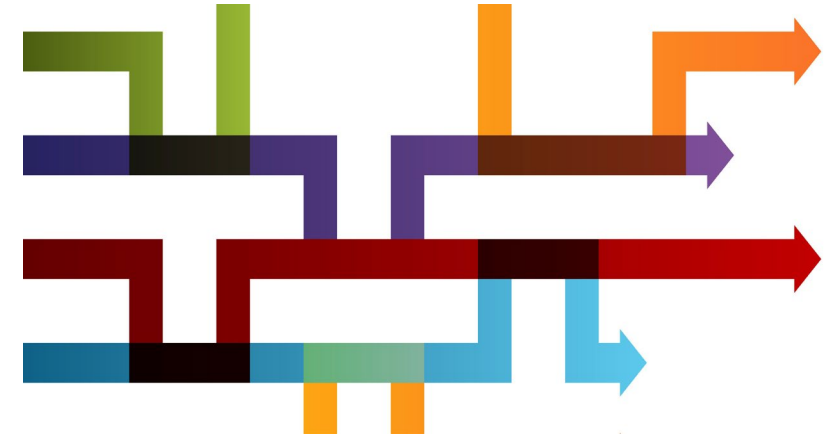
Common Issues:

- Time component

Causal Investigations

*Neither data type collects **continuous** data*

- Behavioral processes may change.
- Chronology of events $\neq$ Causality, Future intentions may drive today's behavior.
- "Cause-Effects" can change roles during the continuous process leading up to the final outcomes (especially with natural field data collection).
- Causality interpretation in the scientific literature in the context of natural data collection is in epistemic terms.
- Fundamentally speaking, given causal processes are inherently latent, all that we really observe is a multivariate distribution of the outcomes.
- Regardless of the type of data available, the best we can do is use a structured conceptual/methodological framework to decompose the multivariate distribution into a recursive sequence of cause-effect relationships.
- Certainly, no reason for researchers to be apologetic about using CS data for epistemic causal extractions.



The Bottom Line



- In a fast-evolving technological, humanitarian, and environmental contexts, just cannot be sure which data collection approach is “BEST”.
- So, rather than stick to any self-assured hubris regarding what is the right way, let’s readily acknowledge what is unknown, and embrace humility.
- In fact, let’s strongly encourage the need for a pluralistic approach to obtaining activity-travel behavior data rather than spending time debating on which data collection method is the “best”.
- The combined insights from single-data studies, as well as from multi-data studies that combine data from multiple approaches (qualitative and quantitative), can be beneficial.

As scholars, let’s channel our time more constructively and ask: “Given we have multiple data collection approaches at our disposal, **how best might we harness the full potential of the different approaches to gather insights into future activity and travel behaviors?**”.



USDOT NATIONAL CENTER FOR UNDERSTANDING FUTURE
TRAVEL BEHAVIOR AND DEMAND

Thank You!

Prof. Chandra R. Bhat

The University of Texas at Austin

Maseeh Department of Civil, Architectural and Environmental Engineering
Department of Economics (Courtesy Appointment)

Email: bhat@mail.utexas.edu

Website: <http://www.caee.utexas.edu/prof/bhat/home.html>

