

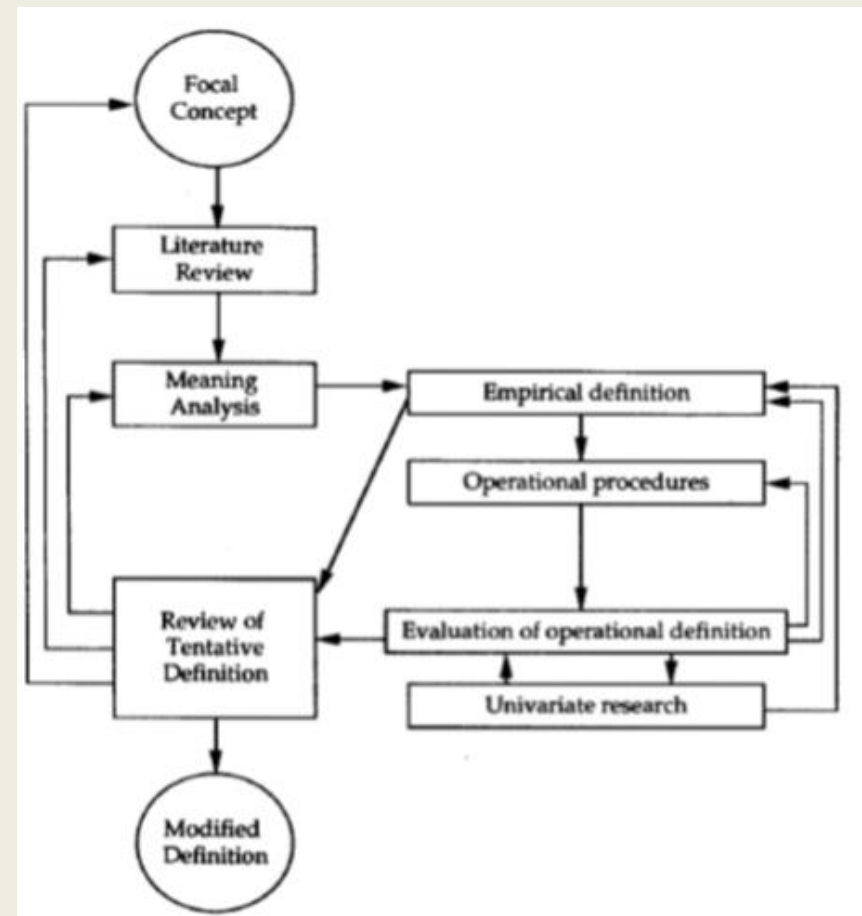
Explanation and Prediction in Social Sciences

Pablo M. Flores
Department of Communication
pmflores@ucdavis.edu

Explanation

Chaffee

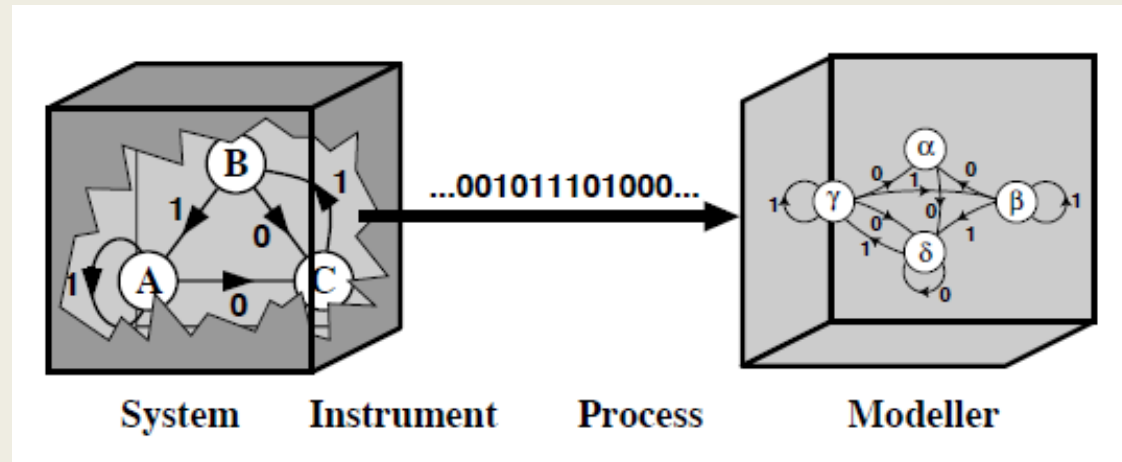
- Long tradition in social sciences
- Test of causal theory
- Constructs
- Operationalization



Prediction

- Historically ignored
- It does not work for causal explanations
- New computational nature of social sciences
- Descriptive modeling

Crutchfield

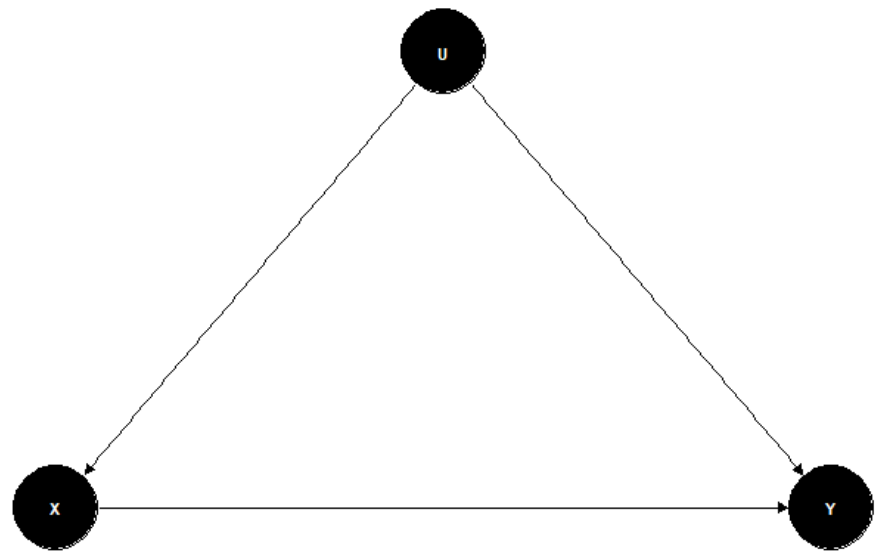


A set of useful methods

Method	Explain or predict	Variable	Stationarity	N of variables	Linearity
Structural Causal Modeling	Explain	Numerical	No	Many	Yes
Instrumental Variable	Explain	Numerical	No	Many	Yes
Granger Causality	Explain/Predict	Numerical	Yes	Two	Yes
Transfer Entropy	Explain/Predict	Categorical	Yes	Two	No
Modes Information Flow	Explain	Categorical	Yes	Two	No
e-Machines	Predict	Categorical	Yes	One	No
e-Transducer	Predict	Categorical	Yes	Two	No
ARIMA models	Predict	Numerical	Yes	One	Yes

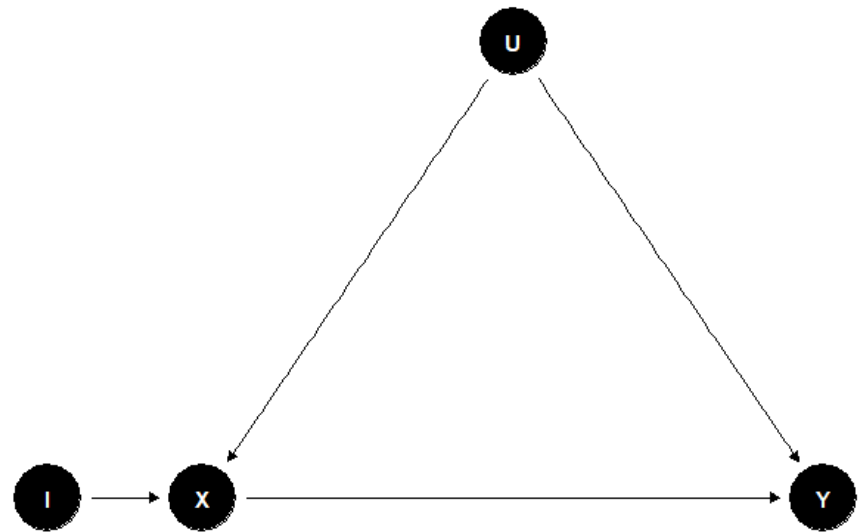
Structural Causal Modeling

- Represented by DAG
- Model based on theory
- Basic structure: chain ($X \rightarrow W \rightarrow Y$), fork ($X \leftarrow W \rightarrow Y$), collider ($X \rightarrow W \leftarrow Y$)
- Analysis: front-door, back-door, Instrumental variables
- Table: Explain, var: numerical, stationarity: no, # var: many, linearity: yes.



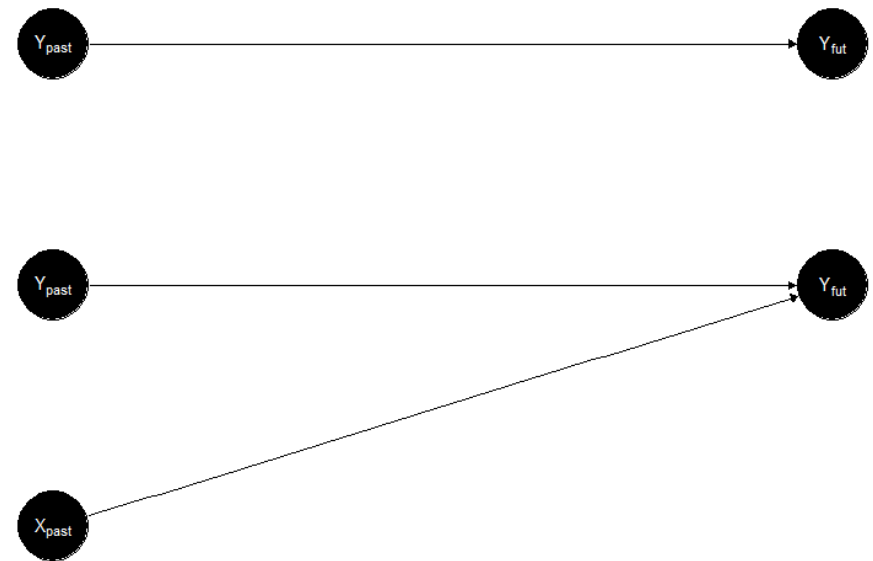
Instrumental Variables

- Represented by DAG
- Model based on theory
- Instrument: I defines causal relationship with X, I affects Y only through X
- Analysis: Factorization
- Table: Explain, var: numerical, stationarity: no, # var: many, linearity: yes.



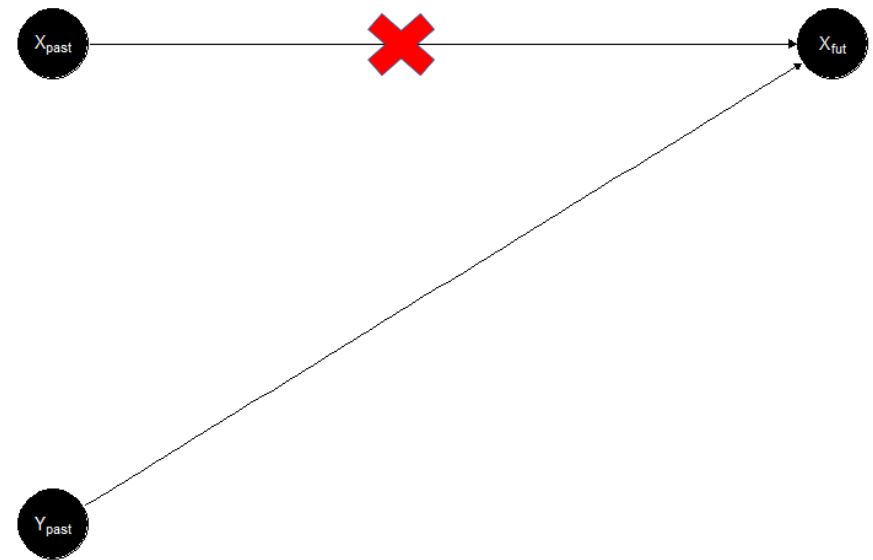
Granger Causality

- Causality?
 - (1) The cause happens before the effect,
 - (2) the cause has unique information about the future values of the effect.
- Determine the time lag.
- Analysis: Comparison between two Models.
- Table: Explain/predict, var: numerical, stationarity: yes, # var: two, linearity: yes.



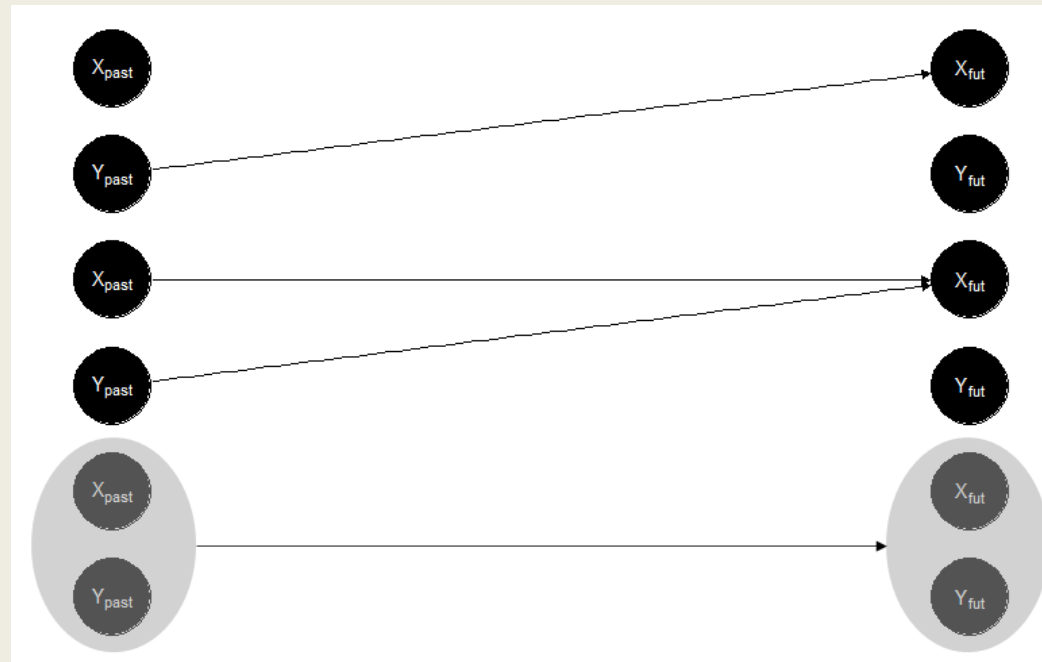
Transfer Entropy

- Mutual influence
- Condition using time-delay and markovian shielding
- Non-parametric equivalent of Granger causality.
- Analysis: Conditional entropies.
- Table: Explain/predict, var: categorical, stationarity: yes, # var: two, linearity: no.



Information flow

- Information decomposition
- Intrinsic flow
- Shared flow
- Sinergistic flow
- Analysis: Intrinsic flow, time-delayed mutual information, transfer entropy.
- Table: Explain, var: categorical, stationarity: si, # var: two, linearity: no.



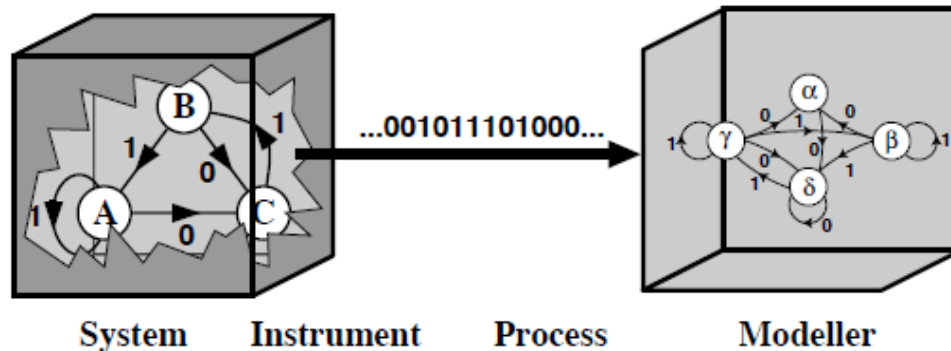
ϵ -Machines

- Identify patterns intrinsic to a process
- Causal States
- Transition probabilities
- Analysis: topological methods, state-splitting, subtree reconstruction
- Table: Predict, var: categorical, stationarity: yes, # var: one, linearity: no.



A set of useful methods

Method	Explain or predict	Variable	Stationarity	N of variables	Linearity
Structural Causal Modeling	Explain	Numerical	No	Many	Yes
Instrumental Variable	Explain	Numerical	No	Many	Yes
Granger Causality	Explain/Predict	Numerical	Yes	Two	Yes
Transfer Entropy	Explain/Predict	Categorical	Yes	Two	No
Modes Information Flow	Explain	Categorical	Yes	Two	No
e-Machines	Predict	Categorical	Yes	One	No
e-Transducer	Predict	Categorical	Yes	Two	No
ARIMA models	Predict	Numerical	Yes	One	Yes



Explanation and Prediction in Social Sciences

Pablo M. Flores
Department of Communication
pmflores@ucdavis.edu