The Paradigm of Econometrics

Based on Greene's Note 1

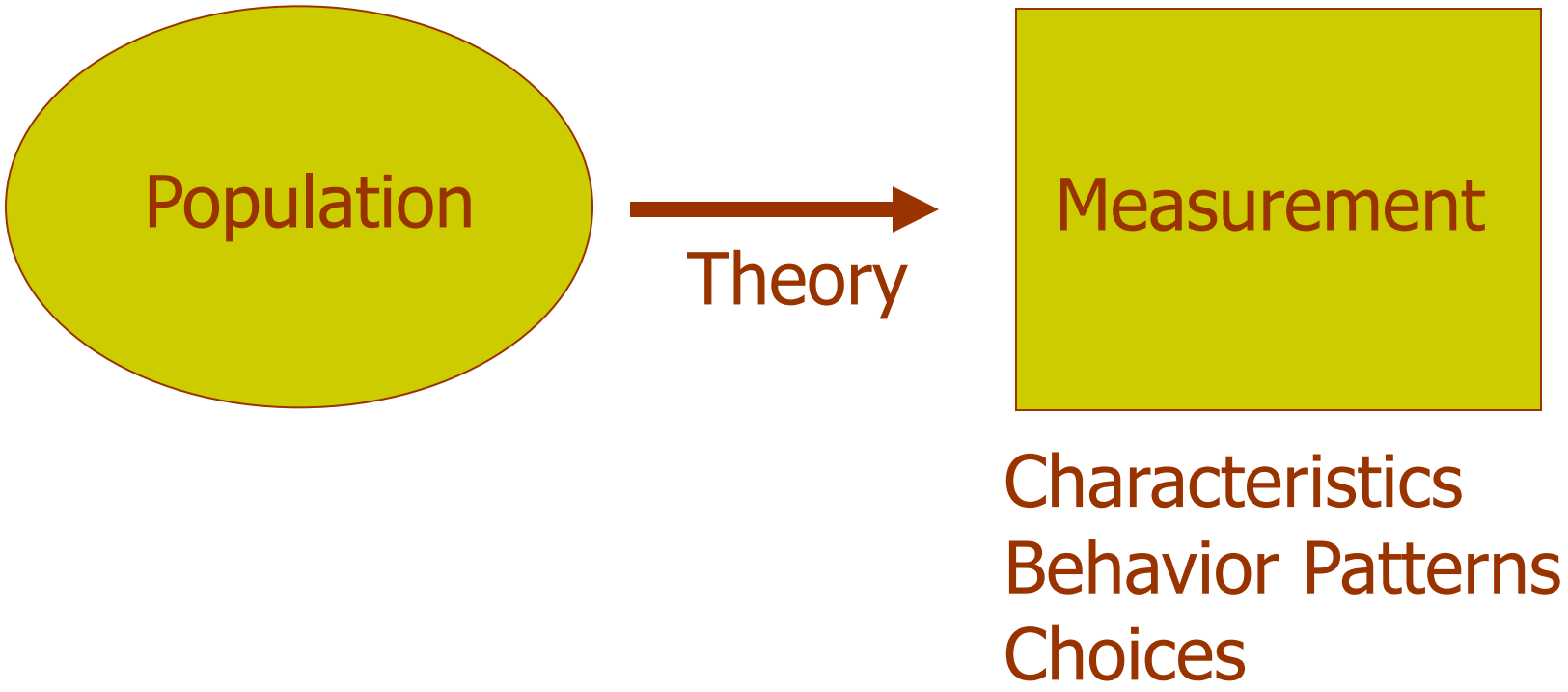
Econometrics: Paradigm

- Theoretical foundations
  - Microeconometrics and macroeconometrics
  - Behavioral modeling: Optimization, labor supply, demand equations, etc.
- Statistical foundations
- Mathematical Elements
- 'Model' building – the econometric model
  - Mathematical elements
  - The underlying truth – is there one?
  - What is 'bias' in model estimation?

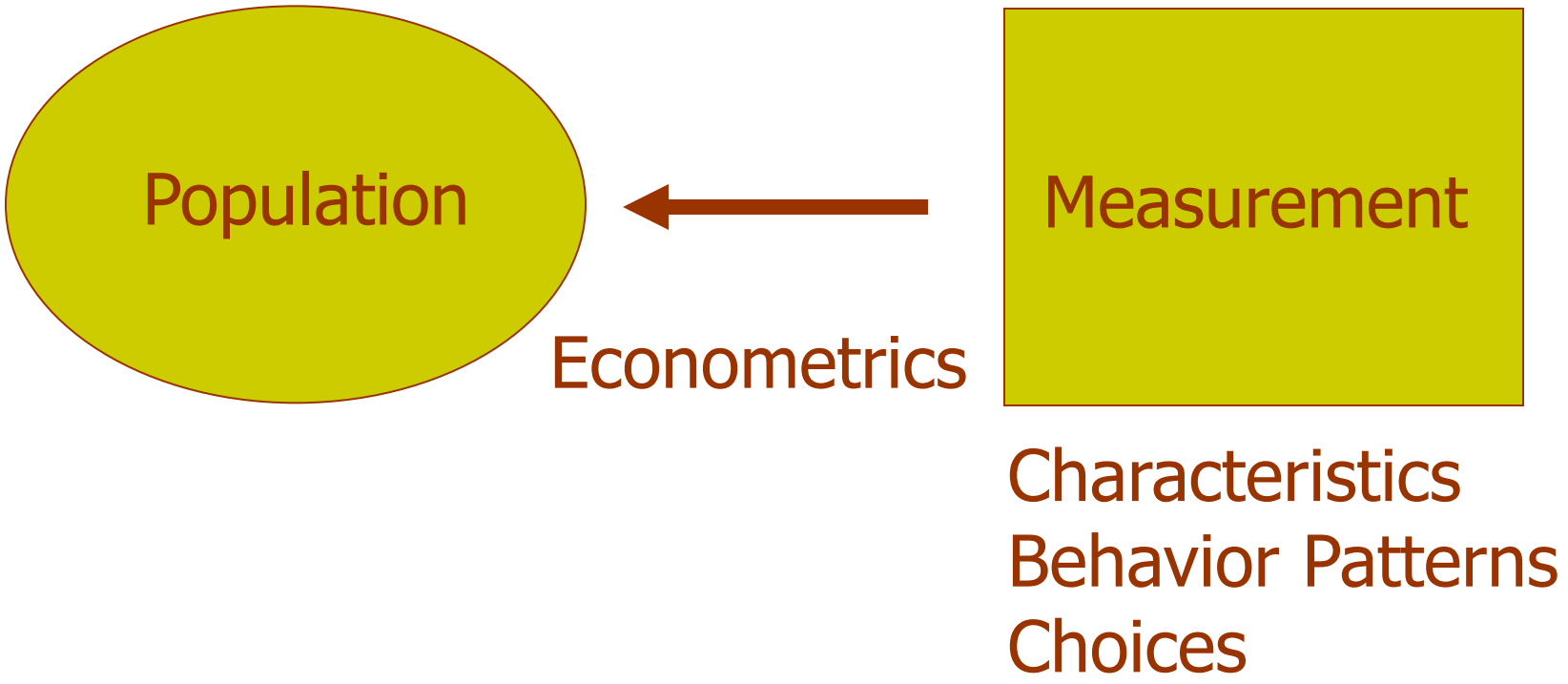
Why Use This Framework?

- Understanding covariation
- Understanding the relationship:
  - Estimation of quantities of interest such as elasticities
- Prediction of the outcome of interest
- Controlling future outcomes using knowledge of relationships

Measurement as Observation



Inference


Population
Econometrics
Measurement
Characteristics
Behavior Patterns
Choices

Model Building in Econometrics

- Role of the assumptions
- Sharpness of inferences
- Parameterizing the model
  - Nonparametric analysis
  - Semiparametric analysis
  - Parametric analysis
- Application: Is there a relationship between investment and capital stock? (10 firms, 20 years)

Nonparametric Regression

Kernel Regression

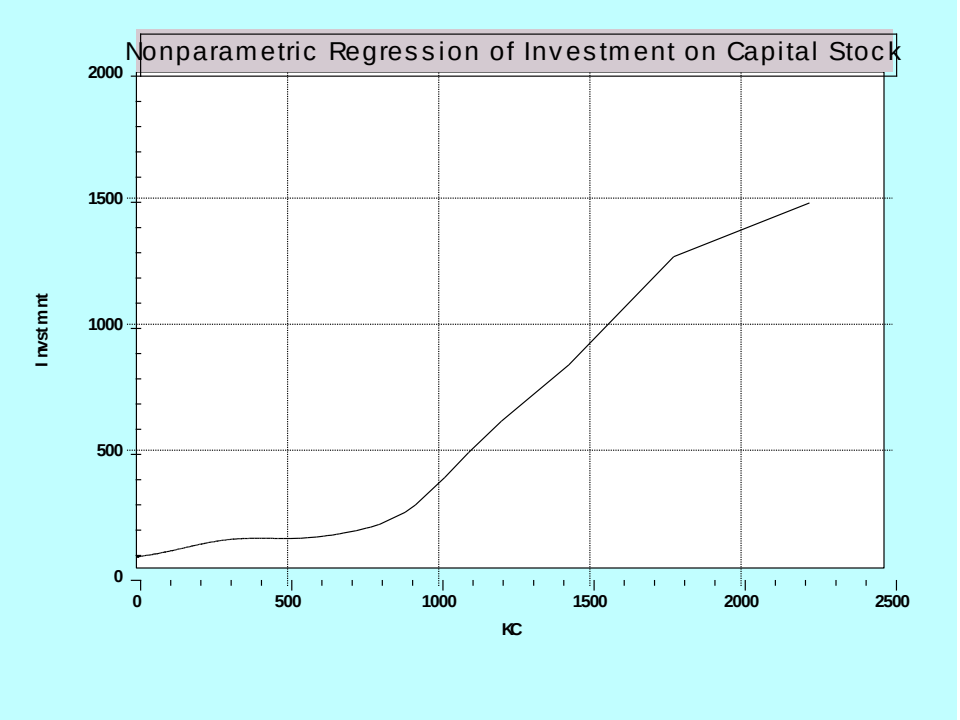
$$\hat{F}(z)=\frac{\sum_{i=1}^{N} w_i(z) y_i}{\sum_{i=1}^{N} w_i(z)}$$

$$w_i(z)=\frac{1}{\lambda} K\left[\frac{x_i - z}{\lambda}\right]$$

$$\lambda = .9s / N^{0.2}$$

$$K(t) = \Lambda(t)[1-\Lambda(t)]$$

$$\Lambda(t)=\frac{\exp(t)}{1+\exp(t)}$$



What are the assumptions?

What are the conclusions?

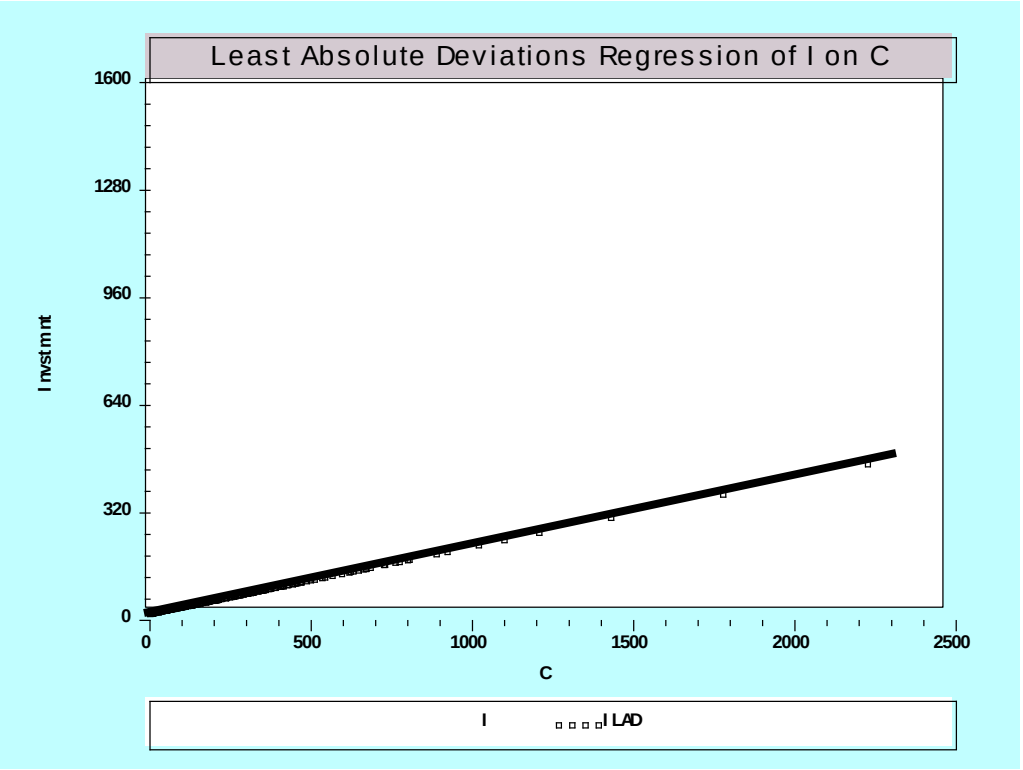
Semiparametric Regression

- $Investment_{i,t} = a + b*Capital_{i,t} + u_{i,t}$
- $Median[u_{i,t} \mid Capital_{i,t}] = 0$

Least Absolute Deviations

$$\hat{F}(x)=\hat{a}+\hat{b}x$$

$$\hat{a},\hat{b}=ArgMin_{a,b}\sum_{i=1}^{N}|y_i - a\text{-}bx_i|$$



Parametric Regression

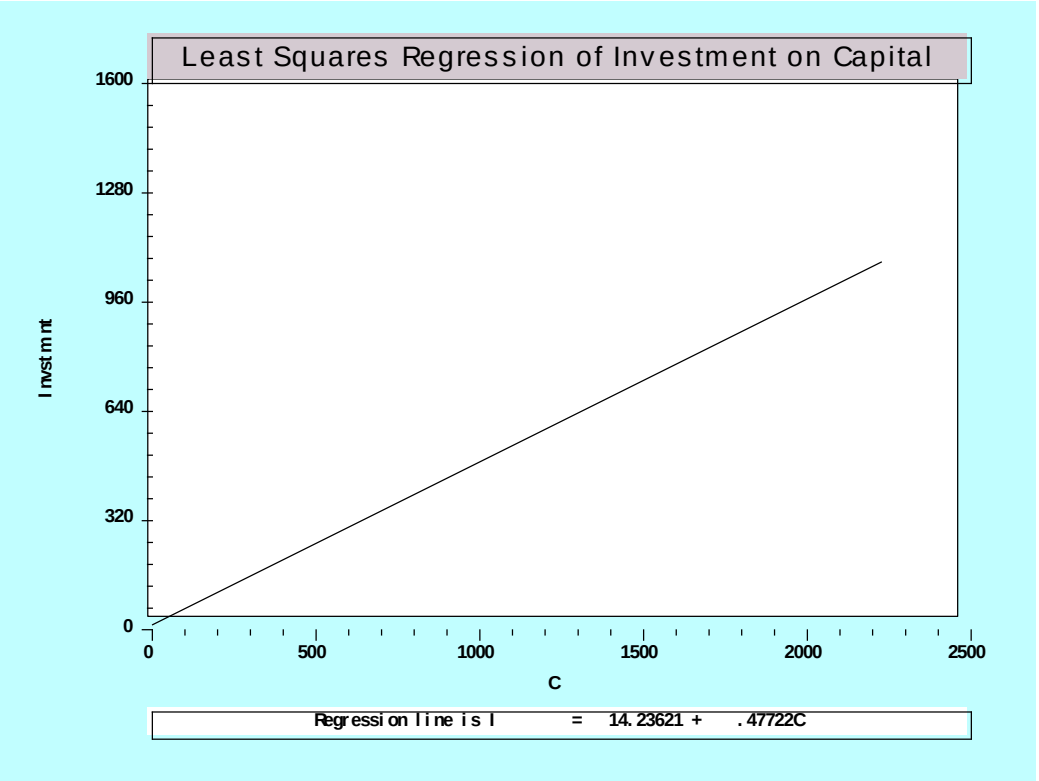
- $Investment_{i,t} = a + b*Capital_{i,t} + u_{i,t}$
- $u_{i,t} \mid Capital_{j,s} \sim N[0,\sigma^2]$ for all i,j,s,t

Least Squares Regression

$$\hat{F}(x)=\hat{a}+\hat{b}x$$

$$\hat{a},\hat{b}=ArgMin_{a,b}\sum_{i=1}^{N}(y_i - a\text{-}bx_i)^2$$

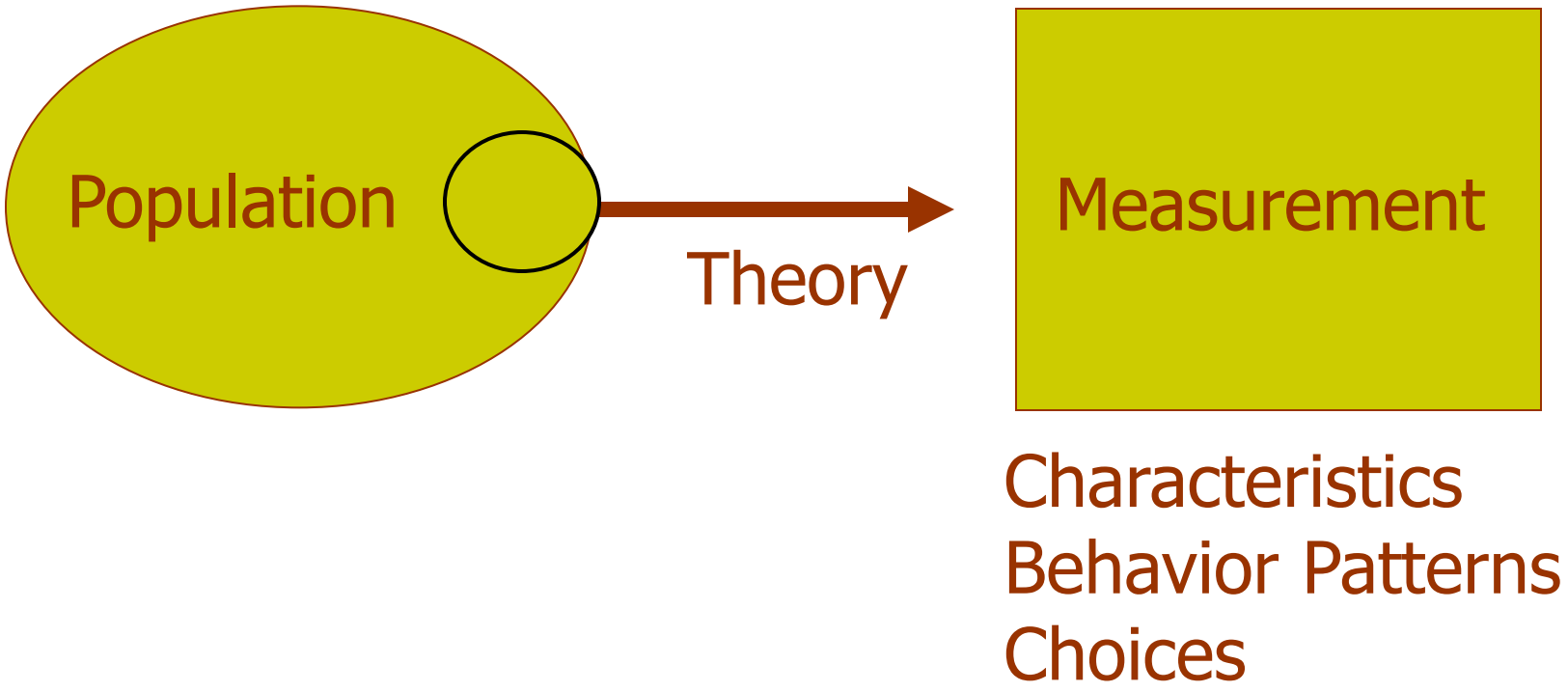
$$=\left[\sum_{i=1}^{N}\begin{pmatrix}1\\x_i\end{pmatrix}\begin{pmatrix}1\\x_i\end{pmatrix}'\right]^{-1}\left[\sum_{i=1}^{N}\begin{pmatrix}1\\x_i\end{pmatrix}y_i\right]$$



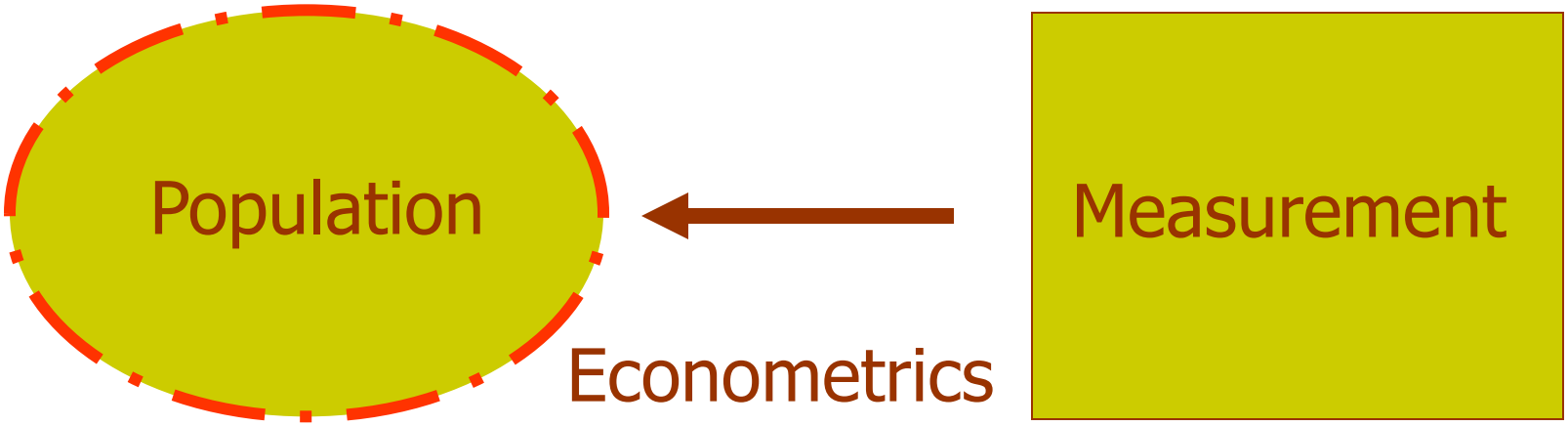
Estimation Platforms

- The "best use" of a body of data
- The accretion of knowledge
- Model based
  - Kernels and smoothing methods (nonparametric)
  - Moments and quantiles (semiparametric)
  - Likelihood and M- estimators (parametric)
- Methodology based (?)
  - Classical – parametric and semiparametric
  - Bayesian – strongly parametric

The Sample and Measurement



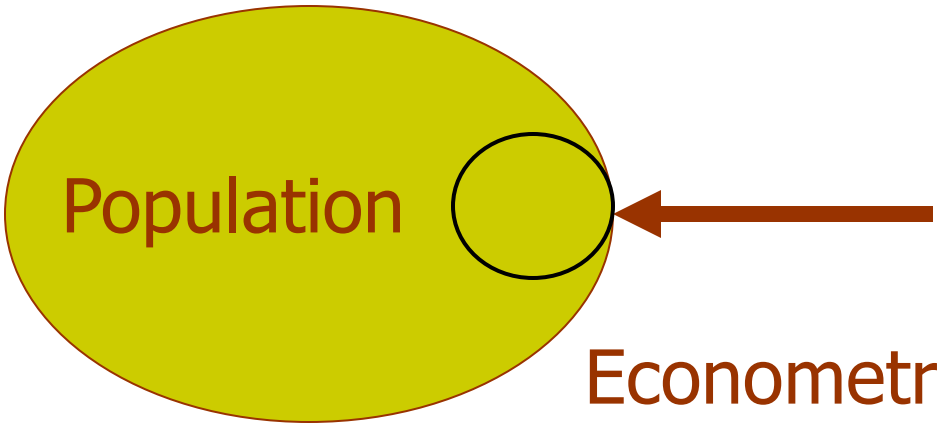
Classical Inference



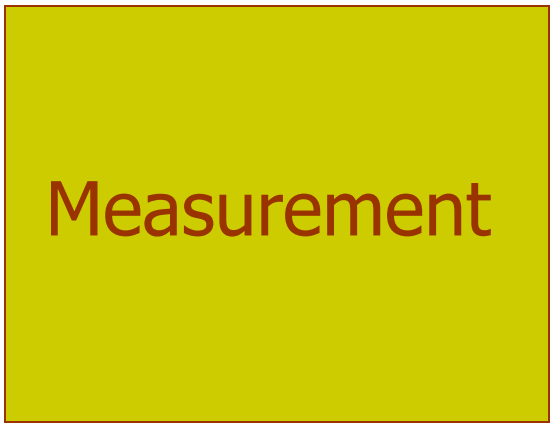
Imprecise inference about the entire population – sampling theory and asymptotics

Characteristics
Behavior Patterns
Choices

Bayesian Inference



Econometrics



Characteristics
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Sharp, 'exact' inference about only the sample – the 'posterior' density.

Classical vs. Bayesian Inference

- Both posit a "relationship" among variables
- They differ on the nature of " parameters" (What is a parameter?)
- Classical can be nonparametric and robust; Bayesian is strongly parametric, and fragile
- Bayesian ***can*** accumulate knowledge (do they?); every classical application is the first.

Empirical Research

- Iterative search for information about the structure
- Specification searches
  - Stepwise modeling, data mining, etc.
  - Leamer on specification searching and significance levels
  - Judge, et al. on sequential inference and pretesting
  - Hendry on the encompassing principle – "general to specific"
- Classical estimation and inference

Data Structures

- Observation mechanisms
  - Passive, nonexperimental
  - Active, experimental
  - The ‘natural experiment’
- Data types
  - Cross section
  - Pure time series
  - Panel – longitudinal data
  - Financial data

Econometric Models

- Linear; static and dynamic
- Discrete choice
- Censoring and truncation
- Structural models and demand systems

Estimation Methods and Applications

- Least squares etc. – OLS, GLS, LAD, quantile
- Maximum likelihood
  - Formal ML
  - Maximum simulated likelihood
  - Robust and M- estimation
- Instrumental variables and GMM
- Bayesian estimation – Markov Chain Monte Carlo methods

Estimation and Inference

- Estimators: Models and estimators
- Properties of Estimators

	Classical	Bayesian
Finite Sample	**Almost none**	**Almost all**
Asymptotic	**Most**	**Also almost all?**

- Hypothesis tests
- Analysis of empirical results

Trends in Econometrics

- Small structural models vs. large scale multiple equation models
- Parametric vs. non- and semiparametric methods
- Robust methods – GMM (paradigm shift?)
- Unit roots, cointegration and macroeconometrics
- Nonlinear modeling and the role of software
- Behavioral and structural modeling vs. "covariance analysis" – pervasiveness of the econometrics paradigm

4 Golden Rules of Econometrics

- Think brilliantly
- Be infinitely creative
- Be outstandingly lucky
- Otherwise, stick to being a theorist

-David Hendry