Section 1  Elements of Econometrics

- Econometric tasks
  - Estimation
    - How big a change in one variable tends to be associated with a unit change in another?
    - What is the elasticity of the demand for asparagus?
  - Testing hypotheses
    - Is the income elasticity of the demand for money equal to one?
    - Does the weather on the day a prospie visits Reed affect his or her probability of attending?
  - Conditional forecasting/prediction/simulation
    - How many more students would Reed need to admit in order to fill its class if tuition were $1000 higher?
    - What will happen to GDP next year if the Fed raises interest rates vs. not?
- Econometric models
  - Deterministic part of model (“Economic model”)
    - What is the dependent (explained) variable?
    - Linear or other relationship among the variables
    - What regressors (independent or explanatory variables) should be included?
    - What are the causal relationships among the variables?
      - Are there variables other than the dependent variable that are endogenous?
      - If so, we need to account for that and think about a model of the behavior of all endogenous variables jointly as a multi-equation system.
  - Stochastic part of model (“Statistical or econometric model”)
    - How should the error term enter?
      - Additive?
      - Multiplicative?
    - What probability distribution might it plausibly follow?
  - Vast majority of econometric analysis is done with linear (or log-linear) models and additive, Gaussian (normal) errors.
  - Specifying the econometric model is the first step of an econometric analysis
- Data
  - Experimental vs. observational data
    - Can we control the independent variables exogenously?
    - If not, are they truly exogenous?
Cross-section data
- Many units observed at one point in time
- Examples include individual Census or survey respondents, states or countries, Reed students, colleges, etc.

Time-series data
- Same unit observed at many points in time (usually equally spaced)
- Examples include national macroeconomic variables

Pooled data
- Observations both over time and across units, but not necessarily the same units in each time period

Panel (longitudinal) data
- Special case of pooled data
- Multiple (same) units observed at multiple points in time
- Examples include state-level or national-level time-series data (for many states or countries), a few survey datasets (e.g., PSID), many colleges observed over time.

- Estimation and testing
  - Determining the proper estimator for the data and model
    - May need to test properties of data to help determine this
  - Performing estimation and testing hypotheses of interest

- Diagnostic evaluation of model
  - Examination of diagnostic statistics
  - Residuals as clues to missing effects
  - Revise model, dataset, and/or estimation method and repeat.

- Assessment of validity
  - Internal validity: Are the assumptions required by the estimators reasonable for the dataset?
  - External validity: How broad is the set of populations to which these results can reasonably be applied?

- What does econometrics do?
  - Maps spaces of assumptions (model, data, estimation method) into space of conclusions (Is hypothesis true or false? How sensitive is this to that?).