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Modeling and Forecasting System-Level Hourly Demand

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Context

- Traditionally and currently, long-run hourly demand forecasting has been conducted "subordinately" to monthly/ annual forecasting
  - This applies to both standard econometric models and, e.g., "hybrid" econometric/ end-use models
  - Annual/monthly and hourly are linked and calibrated, but not fully integrated
- Proposal here is for fully empirically-based, dynamic, integrated estimation
  - This is a state-of-the-art approach – related work being done in a few places

General approach

- Panel data linear regression by hour, year, and TAC area
- Dependent variable: Hourly system-level load
- Model should be estimated on an initial period of ~7 years of historical data, then tested on remaining ~3 years

Proposed independent variables

- Daily temperature (contemporaneous and lagged)
  - Humidity or cloud cover if available
- Previous day's total system demand for given hour
- Monthly and day-of-week fixed effects
  - Dummy for weekday/holiday
- Electricity prices – start will average rates
- Quarterly macroeconomics: GSP, sector outputs/employment
- Quarterly demographics: Population/households customers
- Monthly sectoral electricity load shares (residential, commercial, …)
- Indices or other proxies for energy-efficiency policies/ programs / regulations

Issues include…

- Standard question: Will the assumptions underlying ordinary least squares (OLS) be satisfied?
  - Here, the use of mixed-frequency data - e.g., hourly loads but quarterly GSP – may be an issue
  - There are techniques for dealing with this, but they are more complicated and may not be practical vis-à-vis software implementation
- Recommendation is to start with OLS, testing for heteroscedasticity and autocorrelation
  - OLS will yield unbiased parameter estimates, but variances may be biased – for forecasting, however, this may be a lesser concern
- Weather normalization
- Instead using load-per-customer as the dependent variable
- Representing energy efficiency

Forecasting

- Forecasts will be a hybrid of statistical and scenario
  - Driven by projections of independent variables
- Accuracy over 10-year horizon should be increased over standard approaches
  - However, considerable uncertainty will still be present – e.g., from macroeconomic projections
- The focus on the system level contributes to accuracy/ credibility – aggregates can be more reliability projected than “dis-aggregates”
  - Uncertainty increases substantially if sub-system level loads become the dependent variables