From Load Forecasting To Demand Response

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Outline

- Introduction
- What, Why and How?
- Case study
- Homework
- Project

Introduction
Tao Hong

- Appointment
  - Industry Consultant, Utilities Practice, SAS
  - Instructor, Business Knowledge Series, SAS
  - Chair, IEEE Working Group on Energy Forecasting
- Experience
  - Energy forecasting
  - T&D planning, reliability planning
  - Renewable integration
  - Risk management
  - Retail forecasting
  - Revenue management

Introduction
This Lecture

- Understand basic concepts of demand response
- Learn how to
  - use forecasting techniques to assess demand response impact

Notes and reading materials can be downloaded from the lecture webpage:
http://courses.drhongtao.com/lfdr

What?

- Demand Response (DR)
  - Manage customer consumption of electricity in response to supply conditions
- Load control
- Demand Side Management

Why?
Implement DR

- Cut peak
  - Save kW
- Response to the energy market
  - Save $$$
- Energy conservation
  - Save kWh

Why?
Analyze DR

- Design incentive programs
- Calculate savings
- Marketing campaign
- Design DR programs
- Regulatory reporting

How?
Implement DR

- Programs
- Technologies
- Service infrastructure
- Tariff
- And more…

How?
Analyze DR

- Challenges
  - Irreproducible
  - Irregular activities
  - Limited samples

How?
Analyze DR

- Partition the data
  - Use the loads of the unaffected hours to “predict” the loads of the affected hours
  - But be very careful…
- Use accurate load forecasting models

Case Study

- DR activities (2005-2007)
  - 1297 DR hours
  - 290 periods
  - 252 days

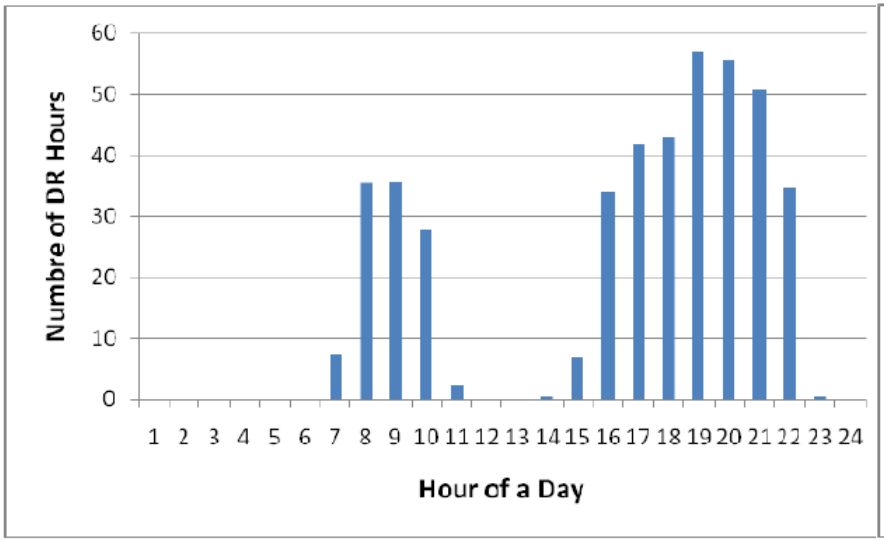


Fig. 1. Summary of DR activities by hour.

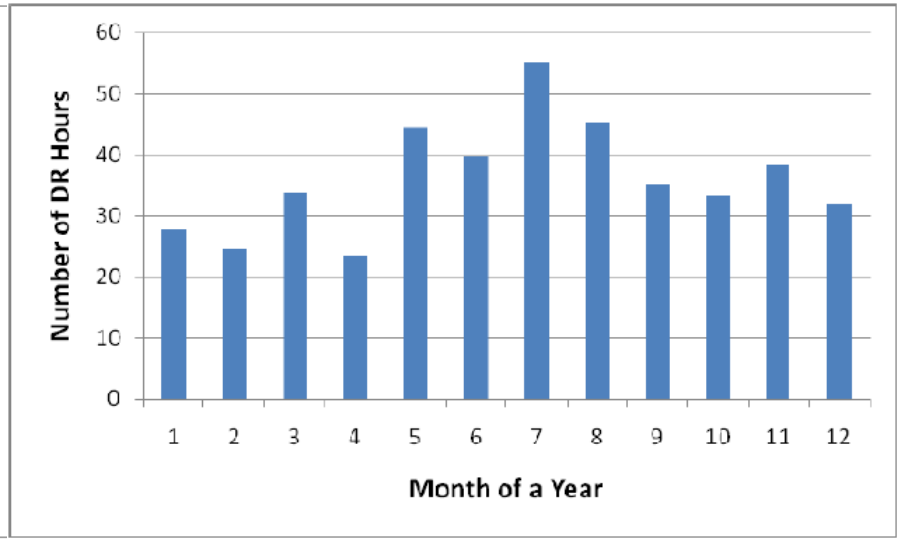


Fig. 2. Summary of DR activities by month.

Case Study
Peak Shedding

What's Wrong?

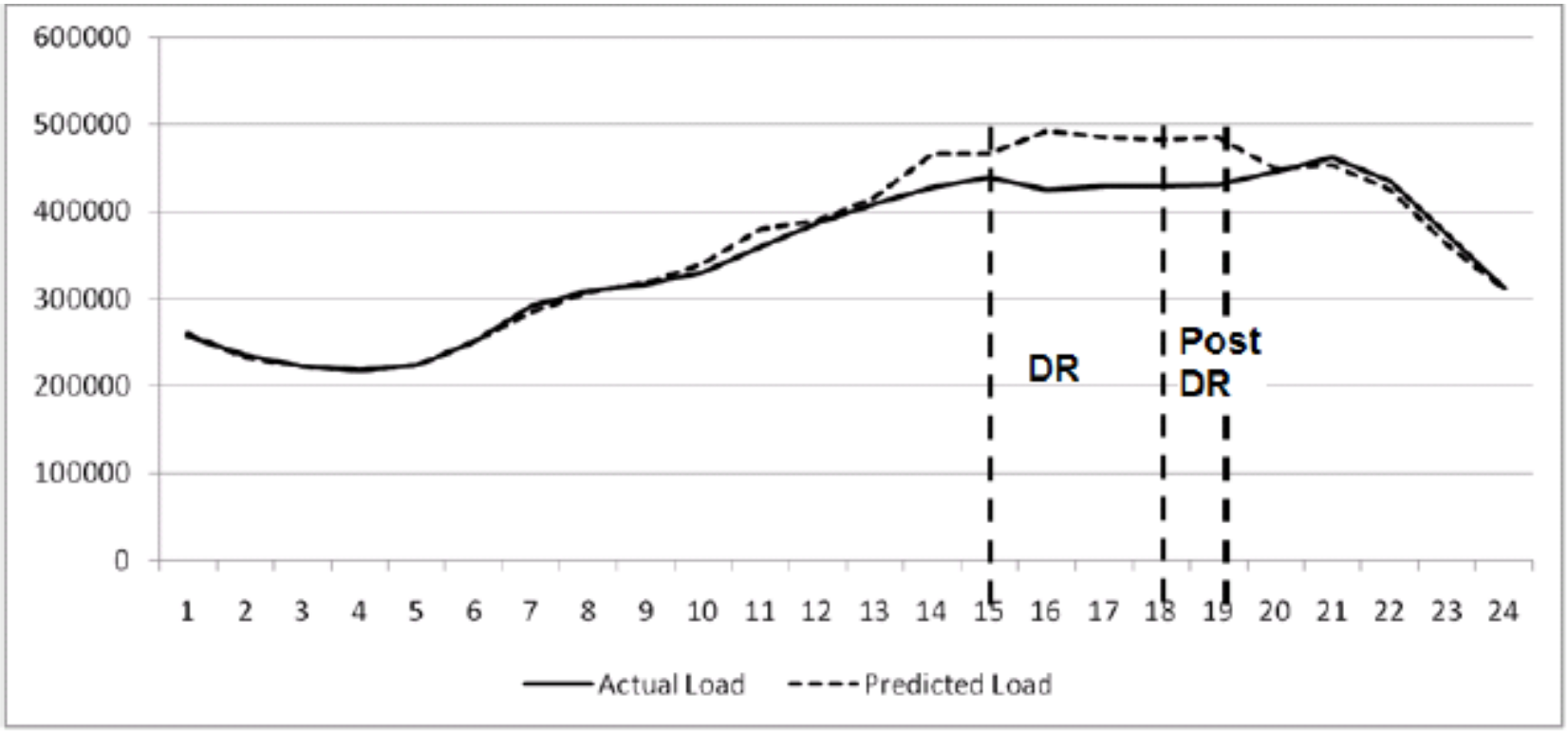
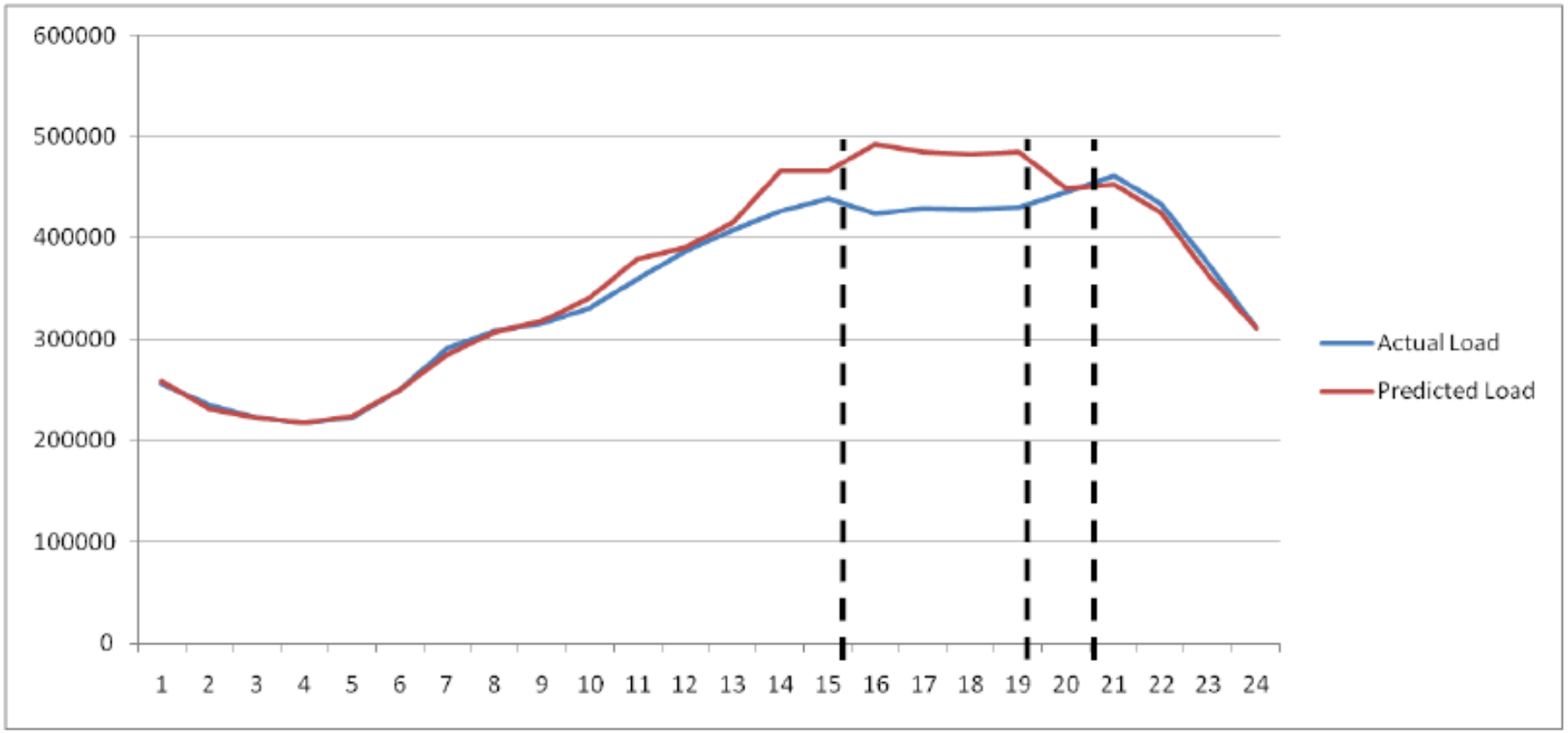


Fig. 3. A load shedding example.

Case Study
Peak Shedding

- No bounce-back effect
- Inaccurate model
- Error in DR activity data

Case Study
Peak Shedding



Case Study
Energy Conservation

- In 3 years (2005-2007)
  - 4.86GWh saved during DR hours
  - 3.32GWh picked up after DR hours
  - 1.54GWh net saving in 3 years
  - 0.51GWh per year
  - 0.016% of annual consumption

ONE hour of electricity per year

Homework

- Data:

  http://sites.google.com/site/hongtao01/courses/dahlf

  http://courses.drhongtao.com/dahlf

- Using the Naïve MLR Benchmarking Model to forecast the loads of Jun 8-14, 2008
  - Use the actual temperatures up to Jun 14, 2008
  - Use load history from Jun 7, 2005 to Jun 6, 2008
  - Report MAPE of Jun 8-14, 2008
  - Plot predicted loads and actual loads

Project

- Forecast the loads of Nov 27, 2008
  - Use load history up to Nov 25, 2008
  - Use the actual temperatures up to Nov 27, 2008
  - Report MAPE of Nov 27, 2008
  - Plot predicted load and actuals loads
- Hints
  - Daylight Savings Time
  - Recency effect
  - Weekend effect
  - Holiday effect
  - And more…

Readings

- Tao Hong, Pu Wang, "*On the Impact of Demand Response: Load Shedding, Energy Conservation, and Further Implications to Load Forecasting*", 2012 IEEE PES General Meeting
- Tao Hong, "*Short Term Electric Load Forecasting*", PhD Dissertation, NCSU

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