Load Forecasting Considerations

Presented by:
Doug Gotham

Presented to:
Indiana IRP Contemporary Issues Technical Conference

Indianapolis, Indiana

October 23, 2014

Using the Past to Predict the Future

- What is the next number in the following sequences?

  0, 2, 4, 6, 8, 10, ….

  0, 1, 4, 9, 16, 25, 36, ...

  0, 1, 2, 3, 5, 7, 11, 13, ...

  0, 1, 1, 2, 3, 5, 8, 13, ...

  8, 6, 7, 5, 3, 0, ….

  8, 5, 4, 9, 1, 7, ….

Why Forecast?

- Load forecasts are used for a number of purposes, from the short-term (unit commitment) to the long-term (resource planning) and in between (fuel procurement, budgeting, ratemaking, DSM program design)

Methods of Forecasting

- Palm reading
- Tea leaves
- Tarot cards
- Ouija board
- Crystal ball
- Polling

- Astrology
- Dart board
- Sheep entrails
- Hire a consultant
- Wishful thinking

Alternative Methods of Forecasting

- Top-down
  - trend analysis (aka time series)
  - econometric

- Bottom-up
  - survey-based
  - end-use

- Hybrid
  - statistically-adjusted end-use

Time Series Forecasting

- Fit the best line to the historical data and assume that the future will follow that line
  - linear
  - polynomial
  - logarithmic/exponential

Advantages

- Relatively easy
- The statistical functions in most commercial spreadsheet software packages will calculate many of these for you
- Requires little data

Disadvantages

- Does not account for changing circumstances

- Choice of historical observations can impact results

- May not be able to get a good fit when there is a lot of variability in the historical data

Econometric Forecasting

- Econometric models attempt to quantify the relationship between the parameter of interest (output variable) and a number of factors that affect the output variable (explanatory variables or drivers

- Example
  - Output variable
  - Explanatory variable
    - Economic activity
    - Demographics
    - Weather
    - Electricity price
    - Fossil fuel prices

Advantages

- Improved accuracy over trend analysis
- Ability to analyze different scenarios
- Greater understanding of the factors affecting forecast uncertainty

Disadvantages

- More time and resource intensive than trend analysis
- Difficult to account for factors that will change the future relationship between the drivers and the output variable
  - utility DSM programs
  - government codes and standards

Survey-Based Forecasting

- Also referred to as "informed opinion" forecasts

- Use information from a select group of customers regarding their future production and expansion plans as the basis for a forecast

- Commonly done with large users

Advantages

- Simplicity
- The ability to account for expected fundamental changes in customer demand for large users, especially in the near-term
  - new major user or customer closing a facility

Disadvantages

- Tend to be inaccurate beyond first few years

  - most customers do not know what their production levels will be five or ten years in the future

  - few customers expect to close shop

  - new customers after first couple years are largely unknown

- Lack of transparency

End Use Forecasting

- End use forecasting looks at individual devices, aka end uses (e.g., refrigerators)

- How many refrigerators are out there?

- How much electricity does a refrigerator use?

- How will the number of refrigerators change in the future?

- How will the amount of use per refrigerator change in the future?

- Repeat for other end uses

Advantages

- Account for changes in efficiency levels (new refrigerators tend to be more efficient than older ones) both for new uses and for replacement of old equipment
- Allow for impact of competing fuels (natural gas vs. electricity for heating) or for competing technologies (electric resistance heating vs. heat pump)
- Incorporate and evaluate the impact of demand-side management/conservation programs

16

Disadvantages

- Tremendously data intensive
- Does not account for consumer decisions that are based on non-economic factors or externalities

Hybrid Forecasting

- Hybrid models employ facets of both top-down and bottom-up models

- Most common is called the statistically-adjusted end-use (SAE) model

- In reality, most end-use models are hybrid to some degree in that they rely on top-down approaches to determine the growth in new devices

Advantages

- In general, hybrid approaches attempt to combine the relative advantages and disadvantages of both model types

- Can better capture externalities that affect customer decisions when compared to end-use models
  - green options

Disadvantages

- Increased model complexity
- More time and resource intensive

Considerations

- What is the appropriate method for forecasting?

- What are the appropriate drivers?

- What are the appropriate assumptions?

- What is the appropriate level of detail?

- What is the appropriate historical period?

* Warning – the opinions expressed are those of the presenter

Method?

- It depends on what you are using it for
  - informed opinion may be okay in the shorter term but not in the longer
  - end-use may be better if you are facing significant changes in codes and standards
- It also may depend on the availability of data
  - with advances in metering technology, we should be able to get better data

22

Drivers?

- There is no one size fits all answer to this either

- It is important to distinguish between correlation and causation

- In my opinion, price is an important driver

Assumptions?

- The underlying assumptions can have a significant impact on the forecast

- In my opinion, the underlying assumptions in the base forecast should have a relatively high degree of probability, with alternate scenarios being used to examine the impact of lower probability events

Level of Detail?

- This depends on a number of factors, like data availability and geographic scope

- Granularity that may be significant at a local level may be less important when looking at a larger region

Historical Period?
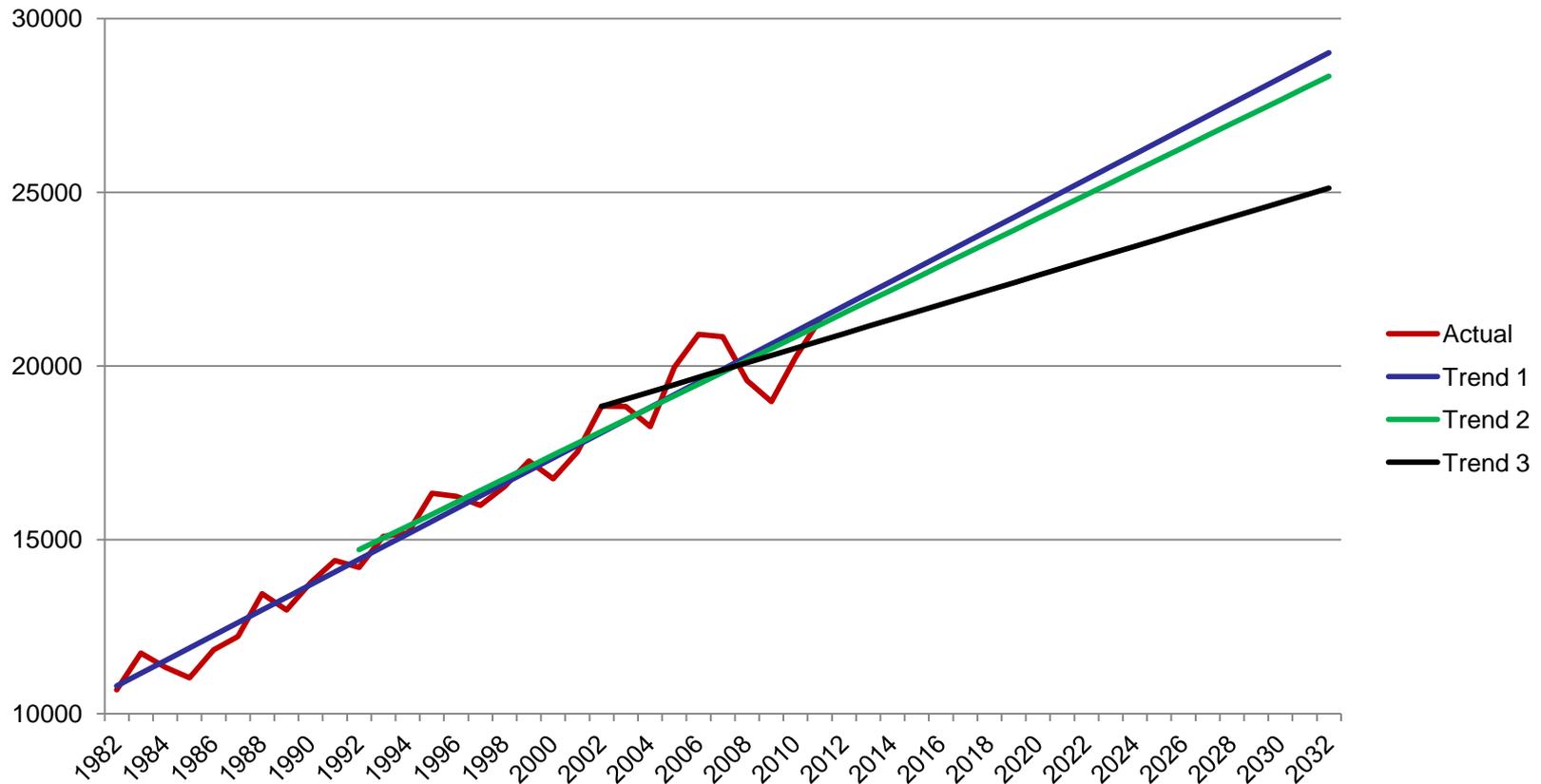
Conclusion

- A good forecast will try to minimize error while maximizing credibility
  - model choice, data, drivers, etc.

- Understanding and communicating the uncertainty around the forecast is important
  - scenario analysis for alternate possible futures