Real-Time Tools for 21-st Century EE Standards, Labels and Programs

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The 21-st century will bring ...

- **Convenient, transparent EE product marketplaces**
- **Exponentially growing amounts of data to inform decision-making**
- **Real-time market, policy and program analysis**
- **Near-real-time field-based energy use verification**
- Behavior-aware and user-customized energy/efficiency ratings
- Automated, economically optimized, individual and product-specific shopping decision support (including upgrade/replacement decisions)
- Solar-powered and solar-assisted appliances and power outlets

search models...

Products

Support

PG&E helps you shop.

Save with energy efficient products.

Energy Score 91

Find energy-saving products
Search, filter & compare the most energy efficient models.

Find energy efficiency rebates
Lower your energy bill and save even more with rebates.

Know what's popular
We analyze sales and user reviews from leading retailers.

These categories feature PG&E incentives

Clothes Washers

Electric Water Heaters

Gas Water Heaters

Refrigerators

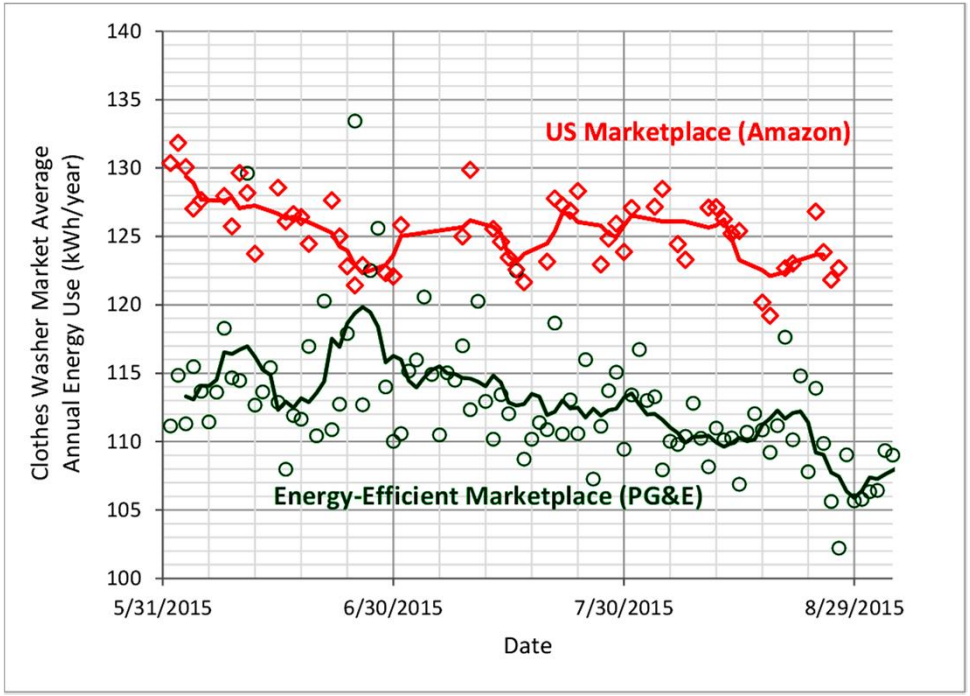
Televisions

Freezers

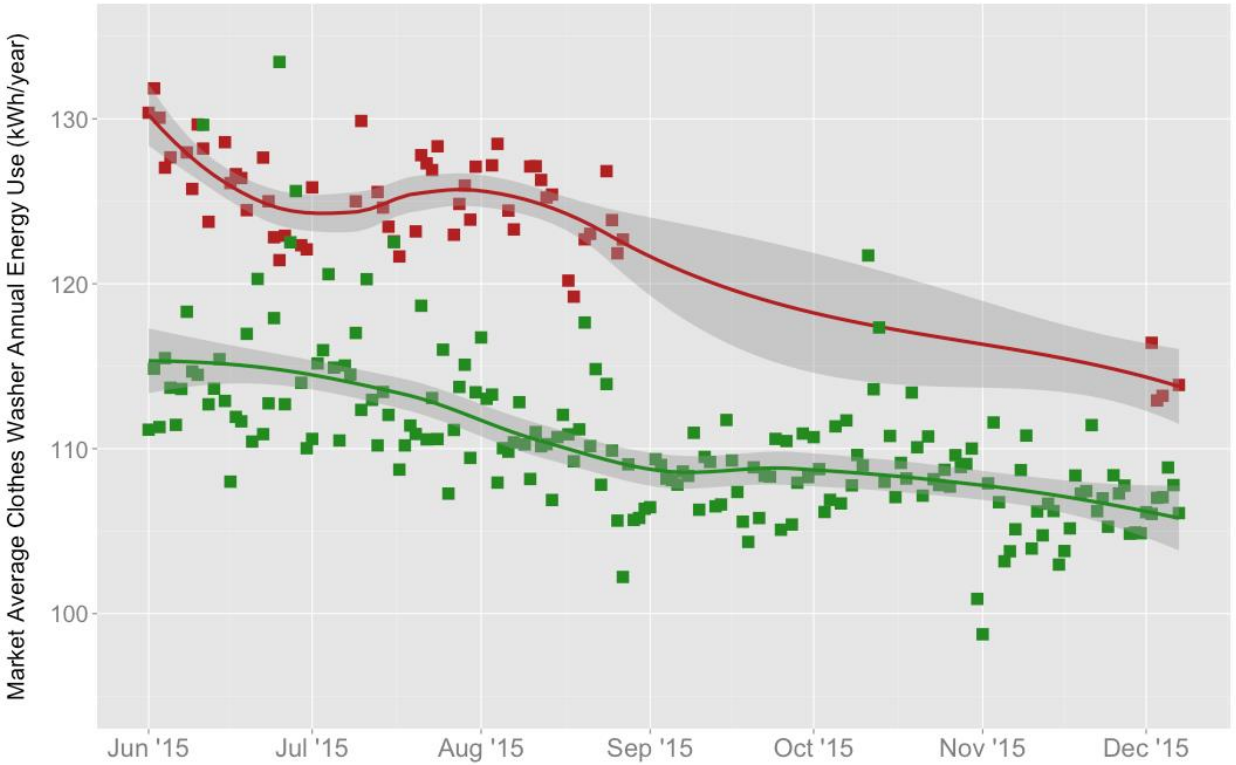
Electric Dryers

EE Product Marketplaces

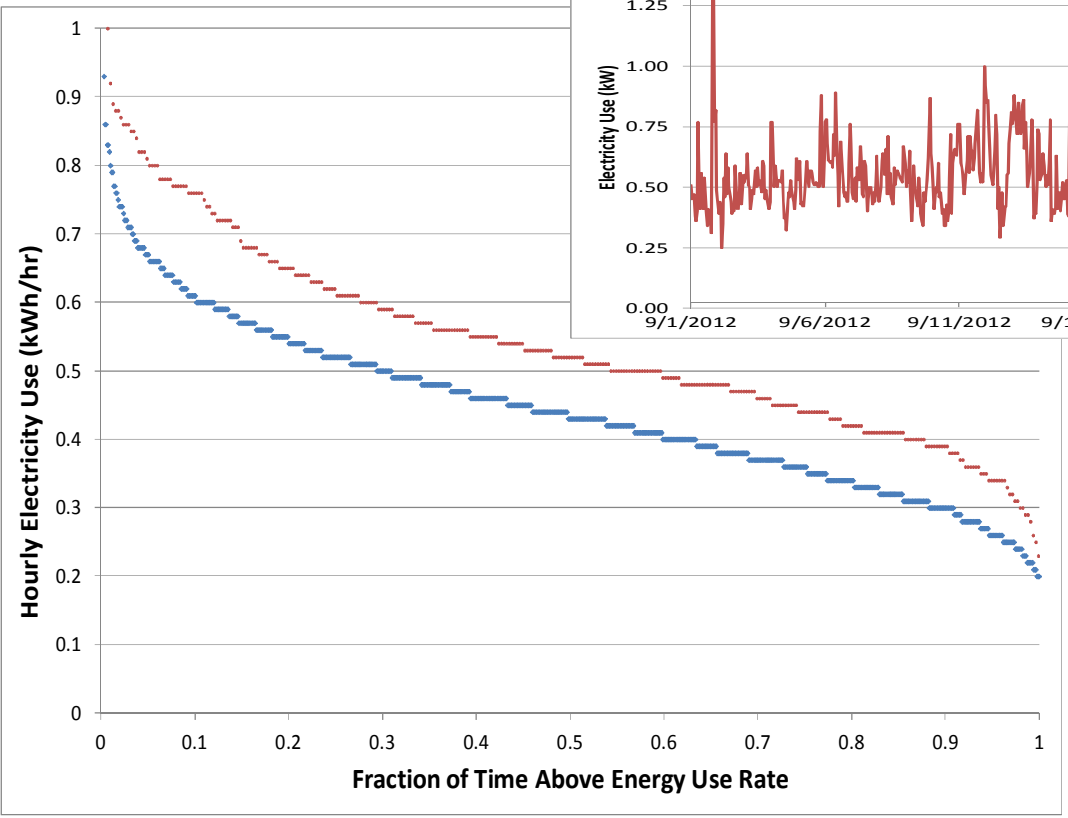
- Makes it easier to find EE products
- Can customize and experiment with EE information
- Can monitor market activity in real time
- Can do rigorous A/B testing of information and incentive elasticities

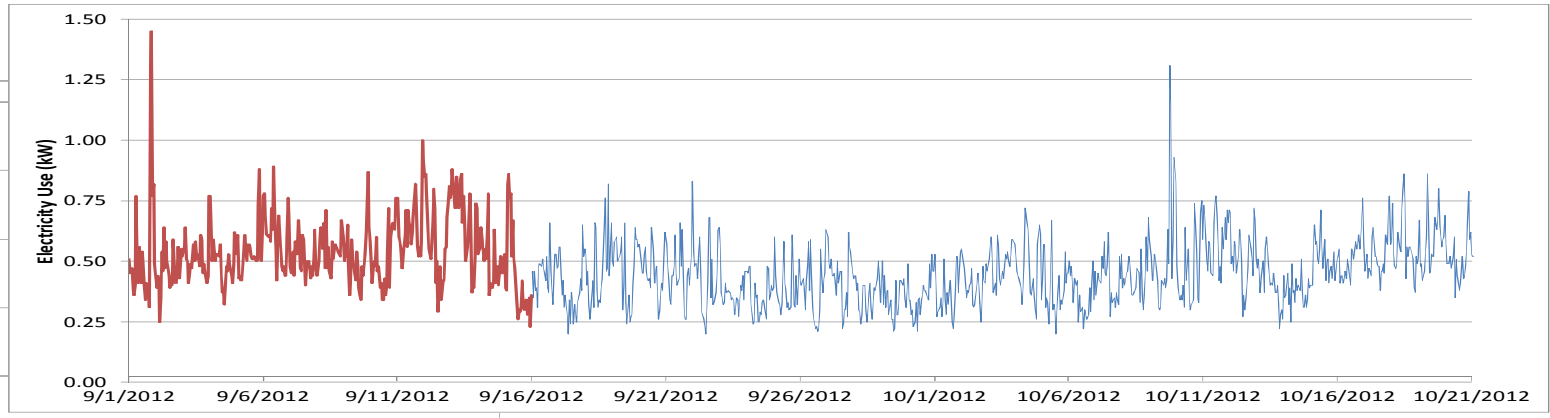


Real-Time Monitoring

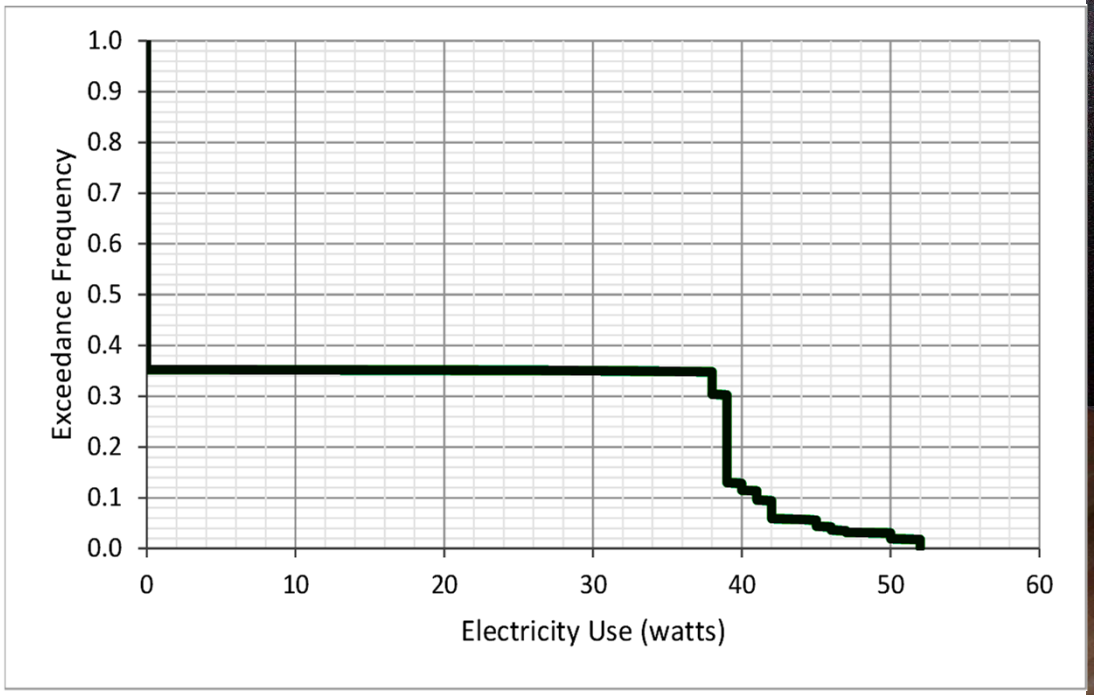


Real-time Field Verification





Cheap/Rapid Field Monitoring



Estimating Market-Average Efficiencies

- The key is relating market hits and market ranks to sales
- Several different methods are possible using different types of Internet data
- Data sources include:
  - Hit counts
  - Search counts
  - Review counts
  - Store counts
  - Sales rank
- Because all count data can be translated into rank data (at least theoretically), we will focus on using relative sales rank data/estimates to make sales estimates

Relating Market Rank to Sales

- If we have a number—*N*—of product models if a particular model has a rank of R, then there are *R*-1 models with more sales and *N*-*R* models with fewer sales.
- The model with the highest sales has a rank of 1
- Models with no sales are not counted
- Almost always, the models with the largest rank have sales of only one unit per time period considered
- The “relative rank” (which we label with a small case letter: *r*) is that number between zero and 1 that is equal to *R*/*N*

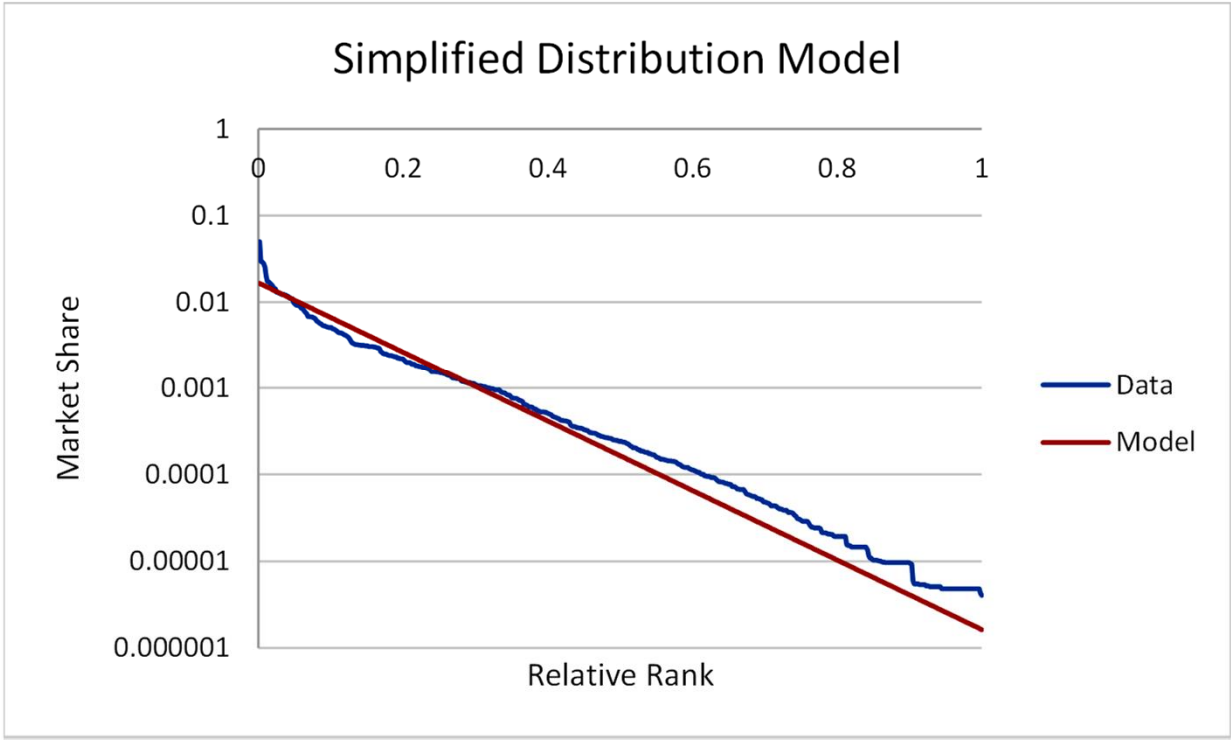
Relating Market Rank to Sales

- A very simple model: An exponential function of rank, or relative rank is a particularly simple model of rank vs. sales
- Note, that with one parameter, we can estimate the distribution function of this particularly simple solution
- That one parameter is the sales of the most popular model: S_{max}
- Because the model with the largest rank has a unit sales of 1, then the approximate solution to the simple distribution function is as follows:

$$S(r) = S_{max} * exp(-ln(S_{max})*r)$$

- Note that this function is equal to S_{max} when r is equal to 0, and is equal to 1 when r is equal to 1

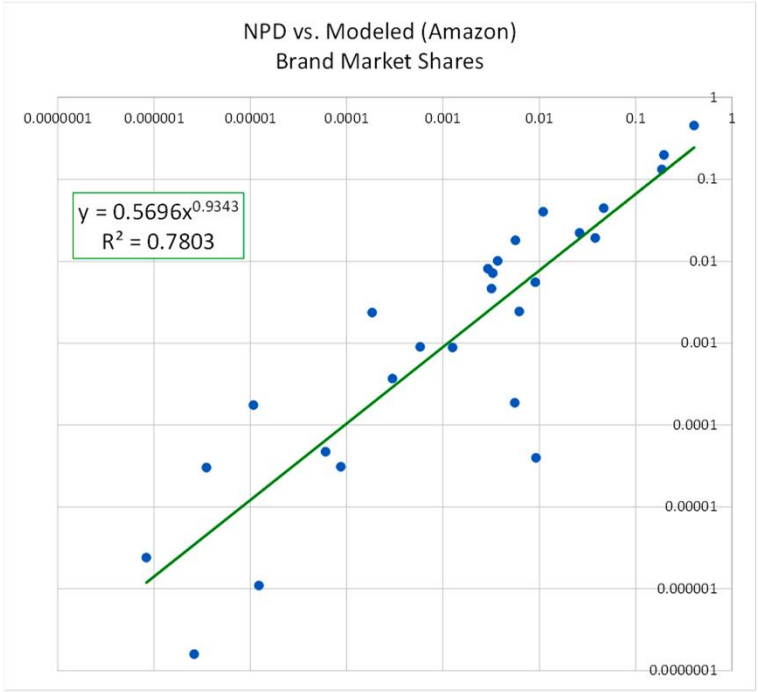
Comparing Equation to Data

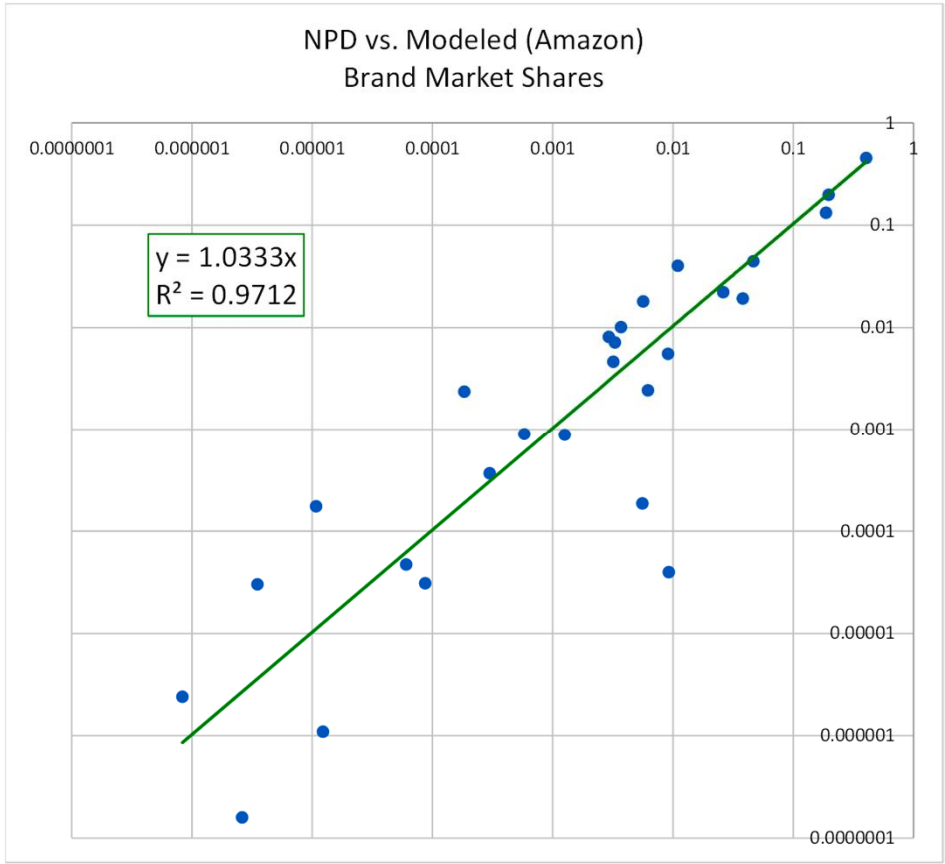


Test results

ÅR-square of linear correlation is 0.97

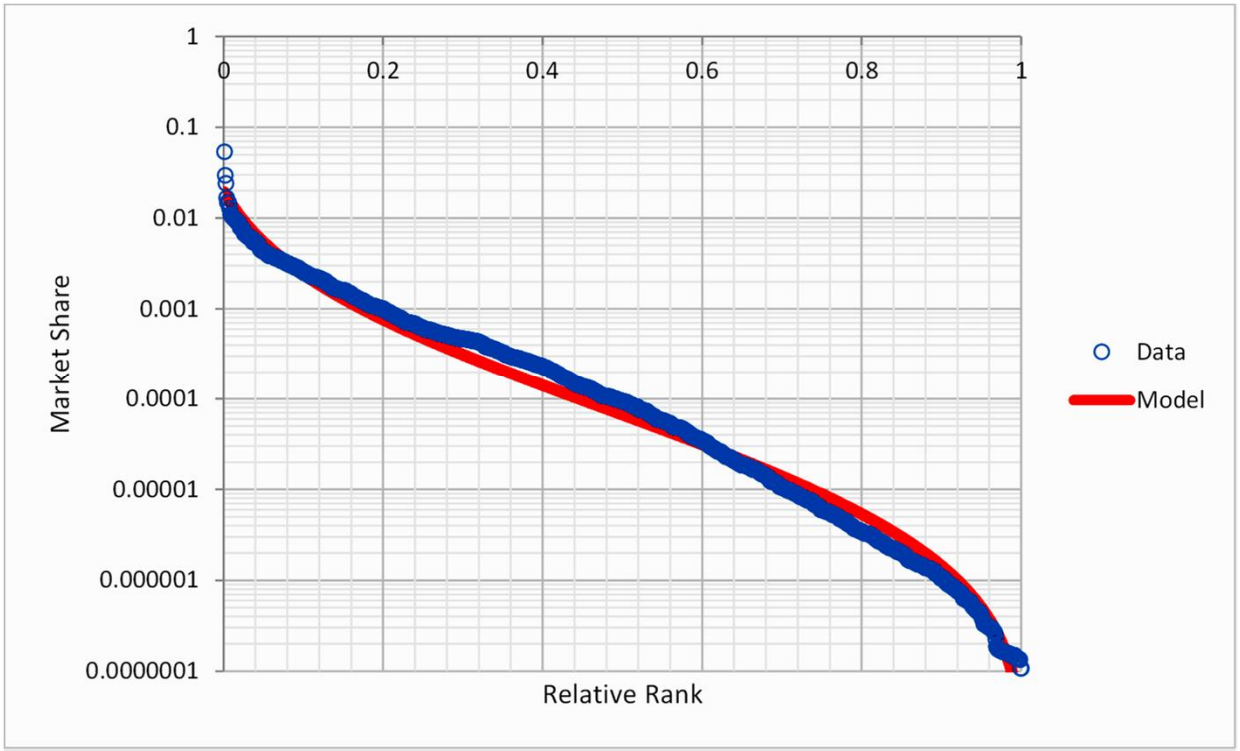
ÅR-square of log-log correlation is 0.78





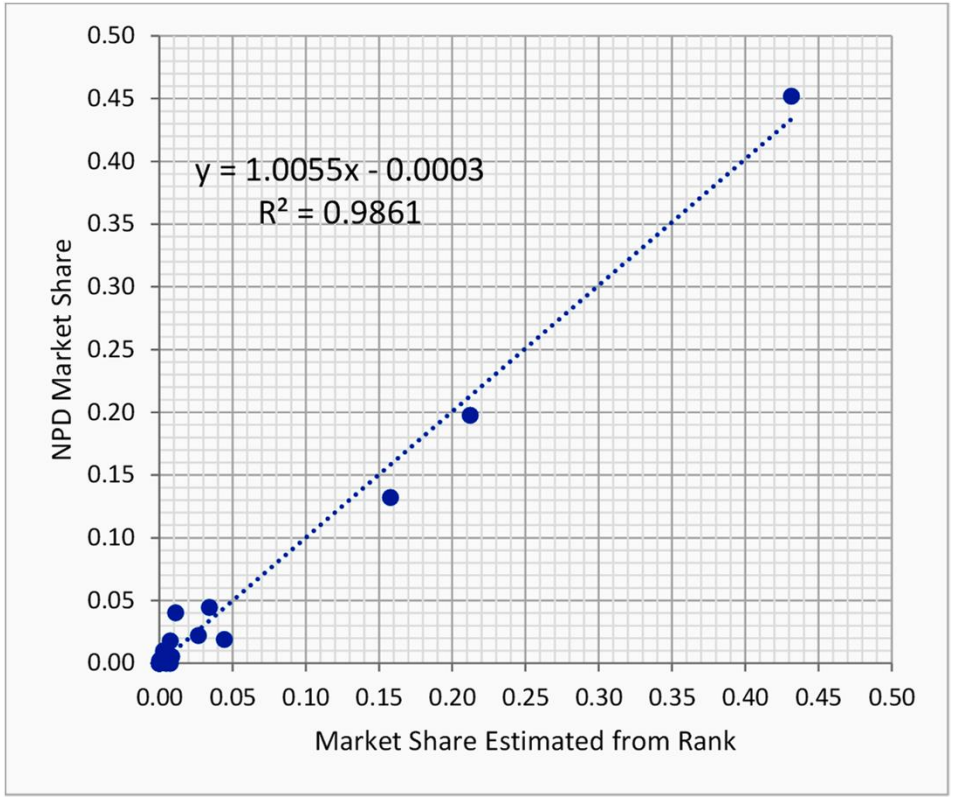
Can Use Fancier Math when Necessary

- Captures curves of function
- Important for larger market shares
- Important for adjustment of exponential slope
- Truncated log normal



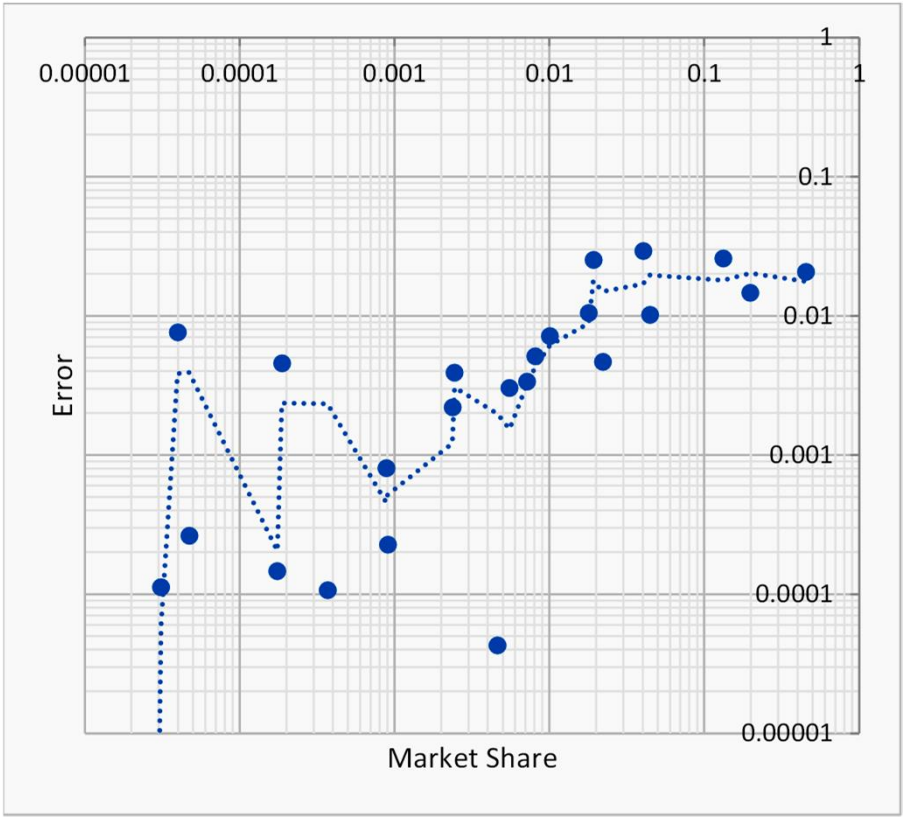
Test of better function

- Apparently smaller errors
- Especially for larger MS's
- Linear R-square is now 0.986

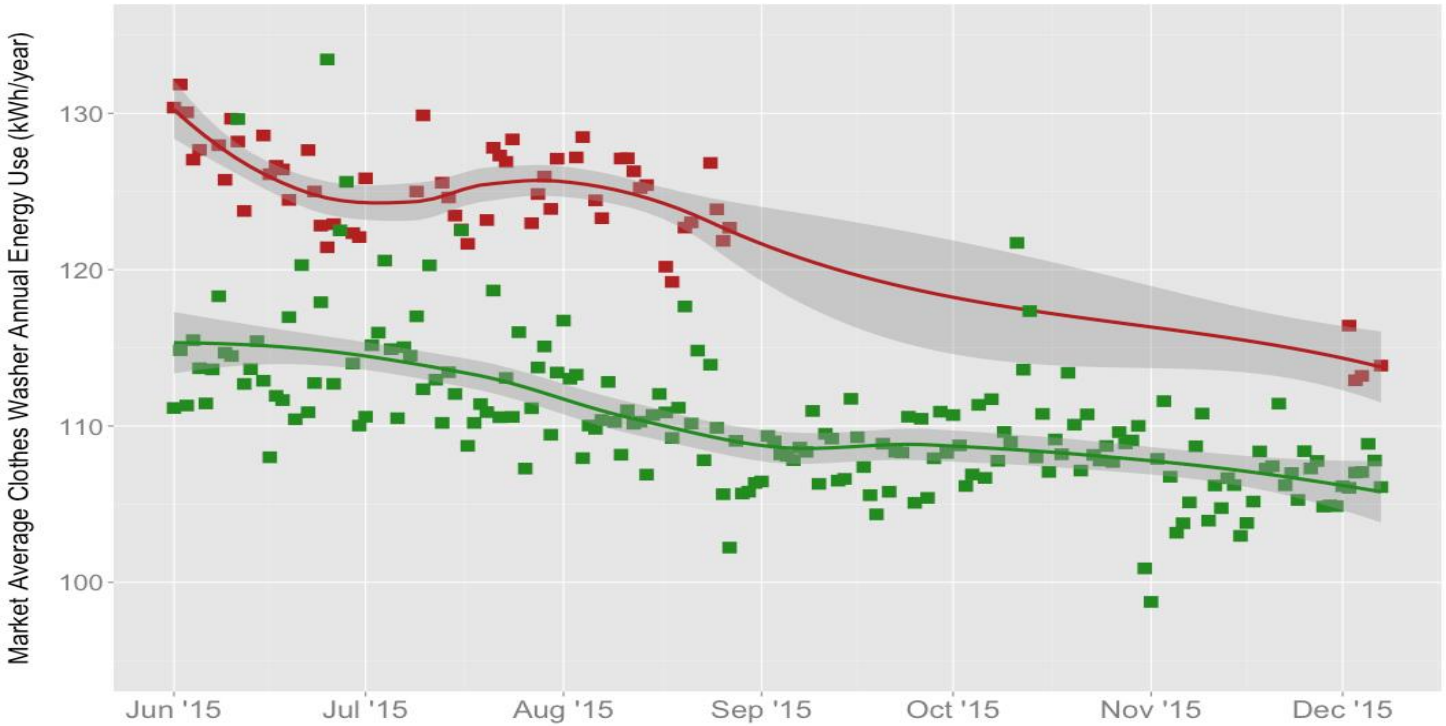


Errors of estimation

- Error is 2% for larger MS's
- Error is proportional to MS for MS's between 0.1% and 1%
- Relative errors are large when measuring MS's smaller than 0.1%



Result: Real-time analytics and monitoring is becoming a reality



Conclusion

Available market data is growing exponentially

So ... we are learning to analyze and organize it in real-time

Field energy use data/measurement is getting exponentially cheaper

So ... field energy use monitoring data is growing exponentially

EE product replacement/purchase transactions are getting rapidly easier/cheaper to create, find, analyze, and encourage

So ... The global market for faster, easier, convenient and more rewarding EE product transactions/purchases will grow very rapidly over the next 5-10 years...helping to accomplish COP21 goals/targets