



Comparison of Bayesian Billing Analysis to Pooled Fixed Effects and Variable-Base Degree-Day

Benjamin Hannas, Ecotope

Michael Logsdon, Ecotope

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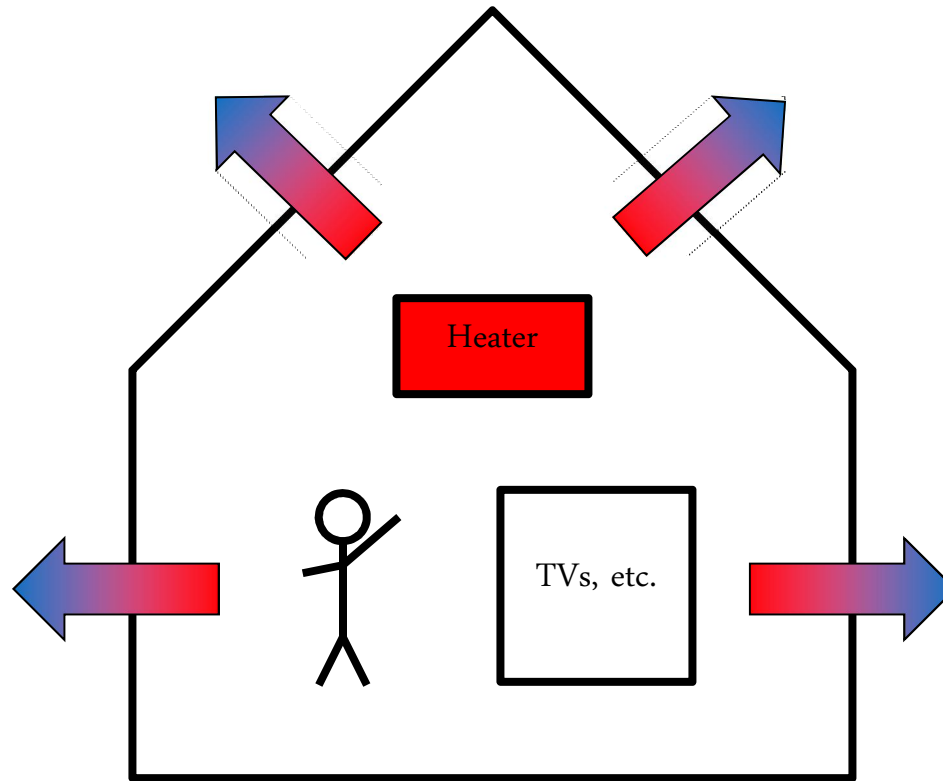
Motivation

- Northwest billing analysis
- 1700 sites
- 20% – 30% attrition
- Re-incorporate lost sites
- Can we improve the process?
- Estimate of error?

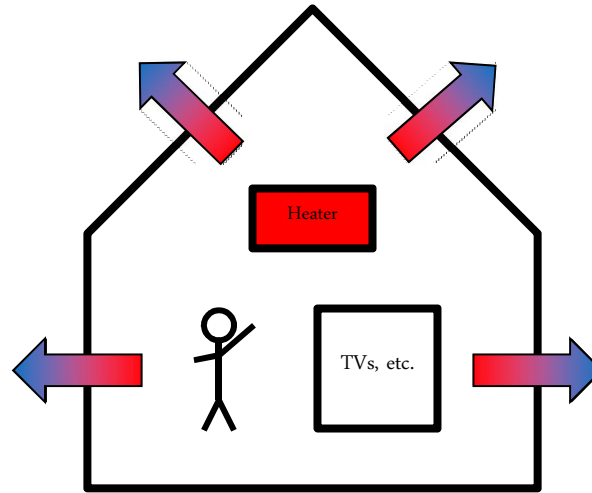
Our Goals

- Less data loss
- Error estimates
- Framework for multiple models

Heat Loss Model



Heat Loss Model



$$\text{Energy} = \text{baseload} + \frac{\text{heat loss}}{\text{efficiency}} (T_{in} - T_{out}) - \frac{\text{internal gains}}{\text{efficiency}}$$

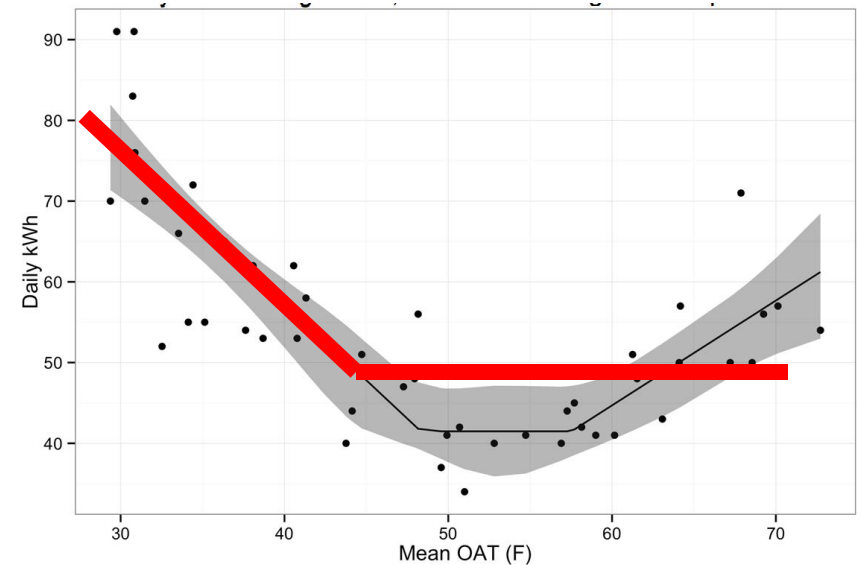
$$\text{Energy} = \text{baseload} + \beta(\tau - T_{out})$$

Common Energy Regression Methods

- Pooled Fixed Effects
 - Single model including all buildings
 - Correlated residuals
- Variable Base Degree Day
 - Two-stage regression
 - Provides individual building results
 - Full error not brought through

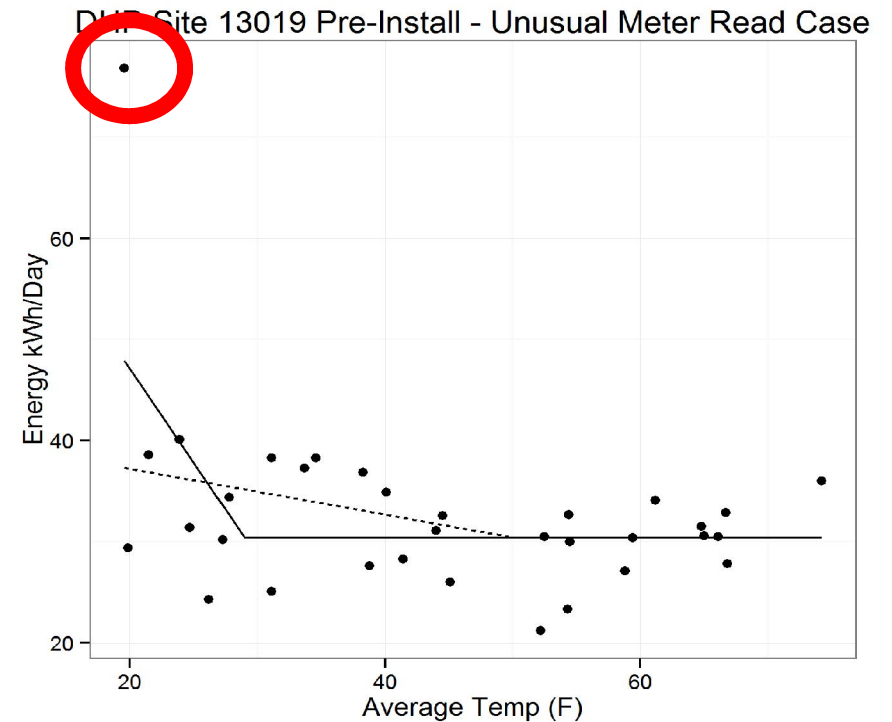
Data Issues

- Model misspecification
- Vacations, etc.
- Not enough bills
- Poor model fits
- Other (bad data, etc.)



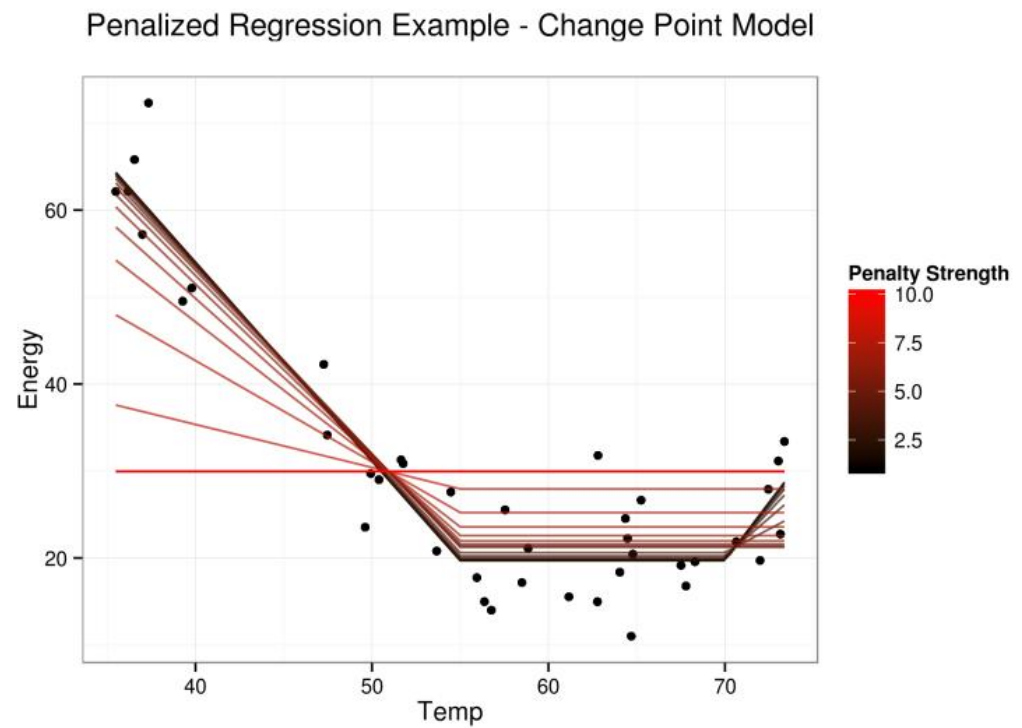
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VBDD Penalized Regression

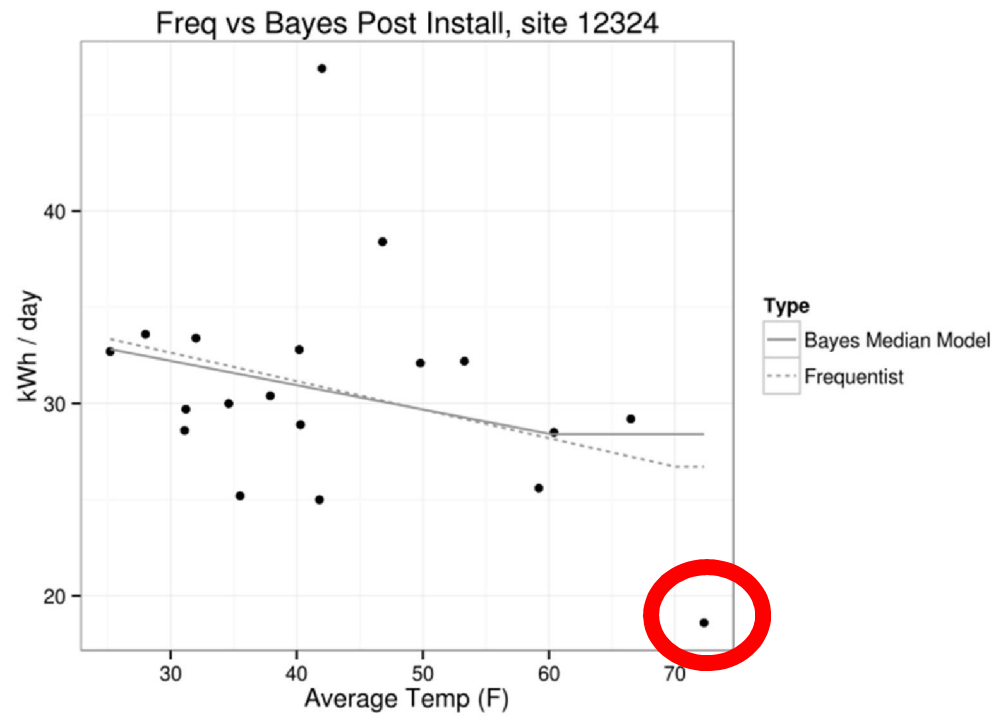
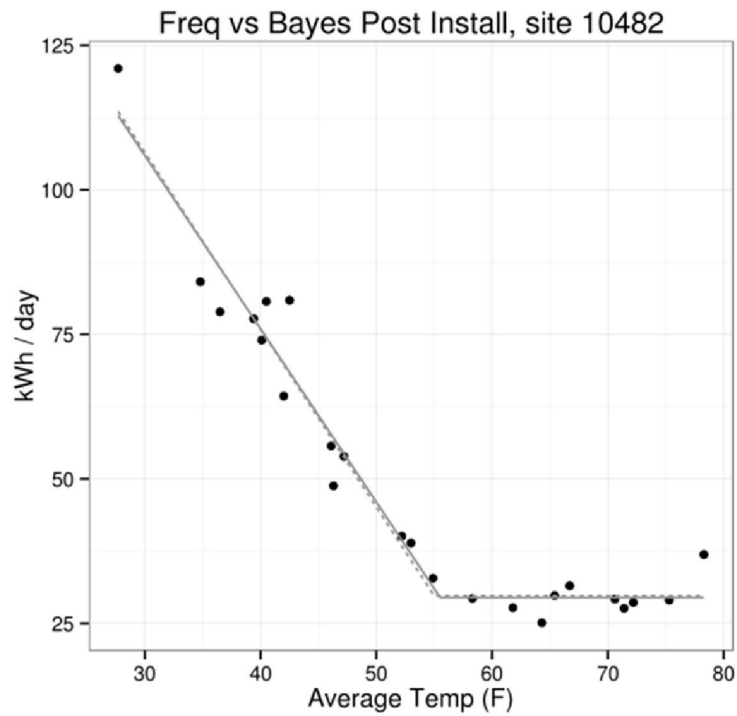
- Model selection
- Less sensitivity to odd points



Bayesian Inference

- Given new data, do we update model?
- Single model, population and individual effects
- Error estimate for each term
- Borrow strength

Borrowing Strength



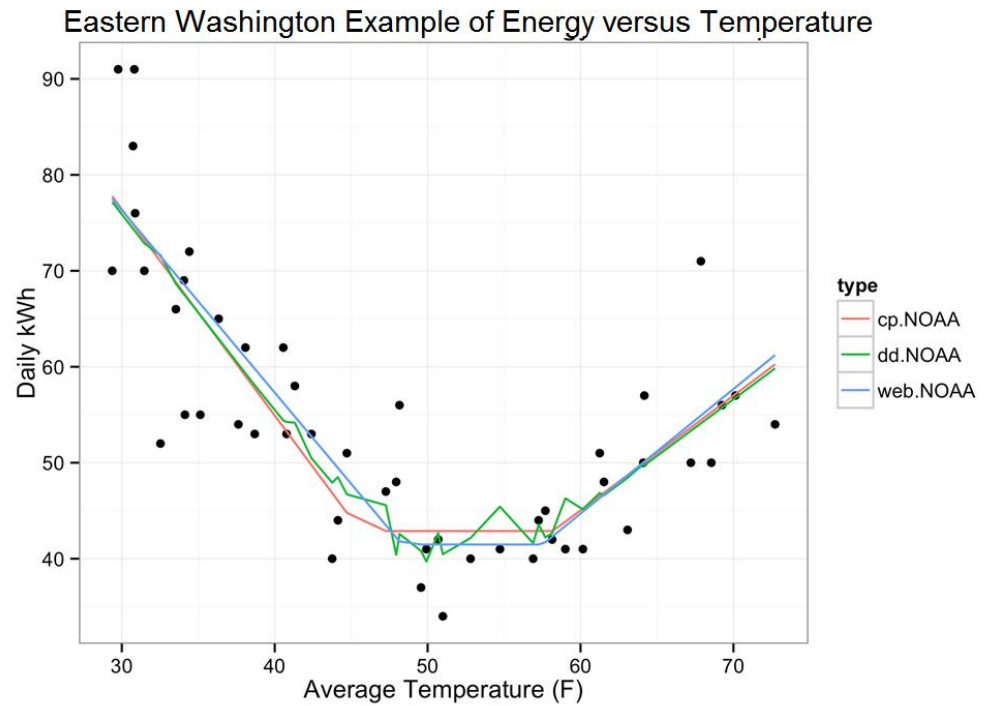
Bayesian Inference

- Much more work to implement
- Computational time
- Again, single model and has error estimate

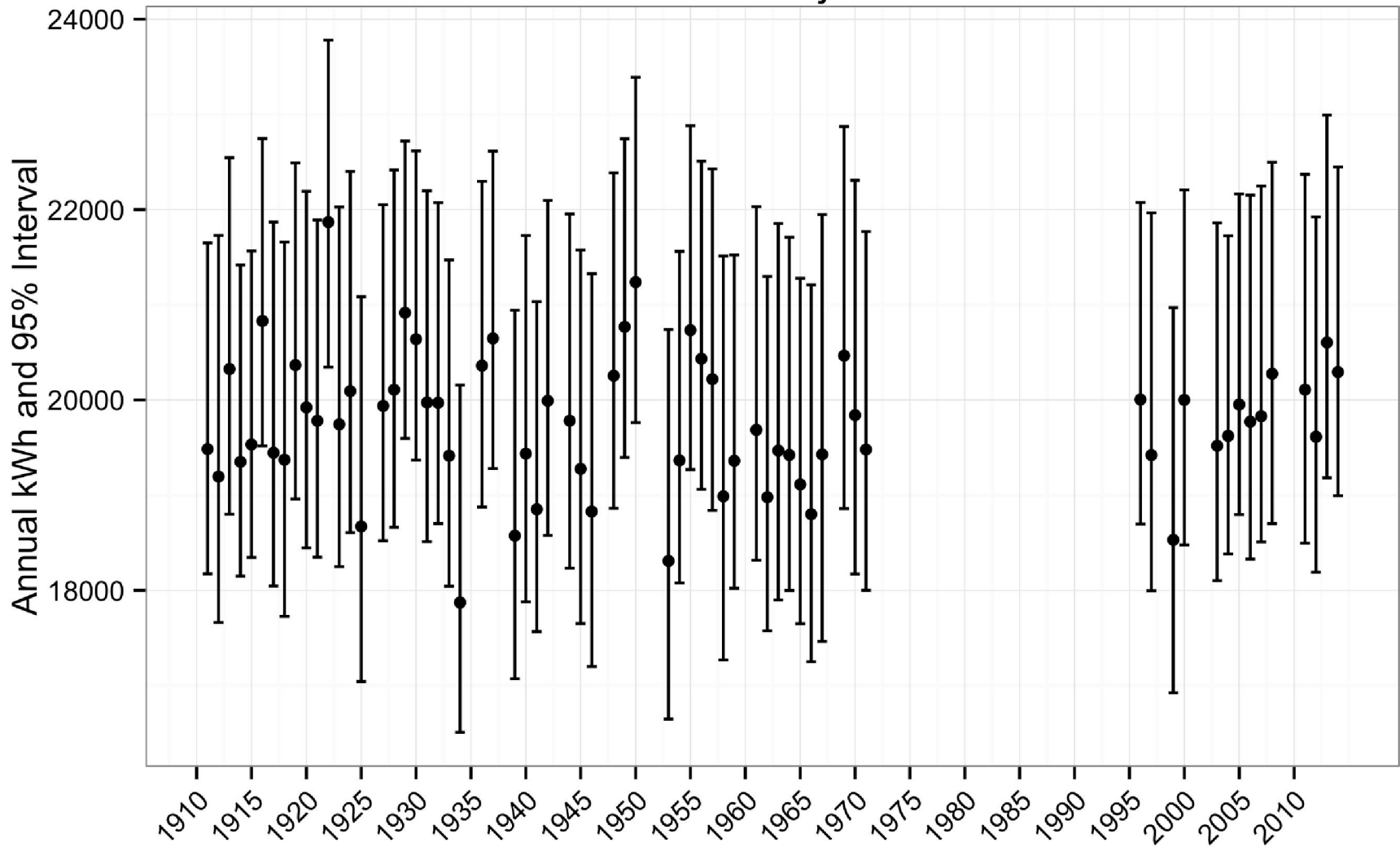
Data Sets

- RBSA Metering
 - 103 sites, metered vs disaggregation
- DHP Retrofit
 - 3,922 sites, pre/post

Ben Hannas
bhannas@ecotope.com
www.ecotope.com



Manclark Manor & Eberhart Estates Probabilistic Projected kWh



Advantages of Individual Site Models

- Investigate outliers
 - QC
 - Characteristics of high/low users
- Overall flexibility in analysis