HOW MUCH DO WE KNOW ABOUT SAVINGS ATTRIBUTABLE TO A PROGRAM?

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Attribution as Causal Inference

- Use domain knowledge, statistical causal models, and data to measure attributable effects

- Current methods include linear fixed-effect regression

Any causal conclusion drawn from observational studies must rest on untested causal assumptions. – Judea Pearl (2014)
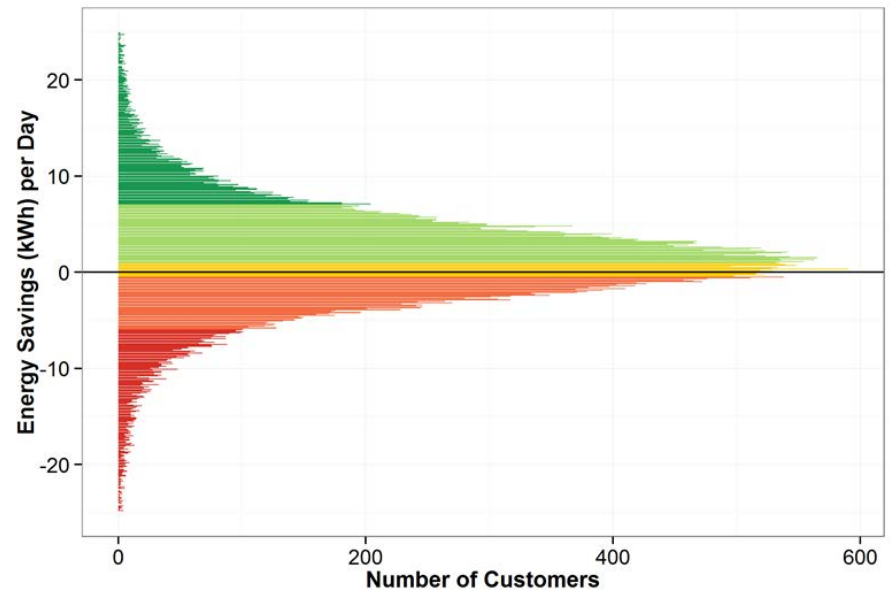
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Where we are

Where we can be

0.9 ± 0.1 kWh/day

Opportunities

- Multilevel Models for Individual Savings

- Bayesian Additive Regression Trees for Individual Savings

- Bayesian Statistically Adjusted Engineering (SAE) Models
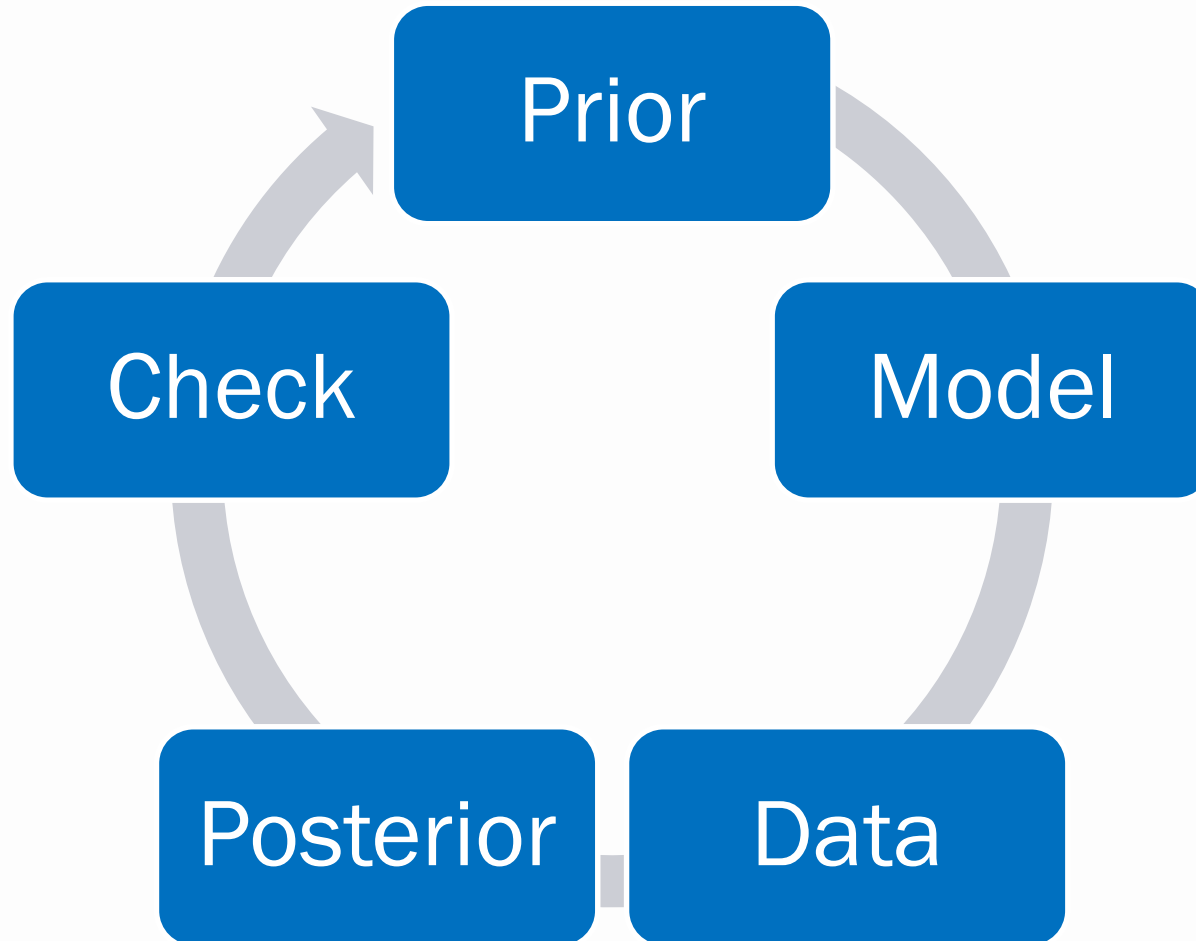
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Multilevel Models

- Individual savings (impact) estimates

- Includes data from control/comparison group

- Assumes normal distribution of savings

- Extension of linear models
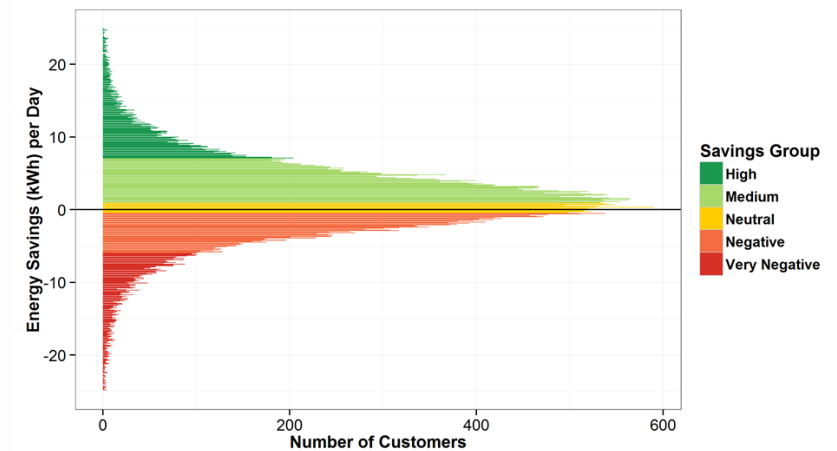
Bayesian Paradigm

Bayesian Additive Regression Trees (BART)

- Individual savings (impact) estimates

- Uses control/comparison group

- Relaxed distributional assumption of savings

- Extension of Random Forests machine learning technique

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Bayesian SAE Models

- Measure-specific savings (impact) estimates

- Uses engineering estimates for prior information

- Much better properties than classic SAE models

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Risks and Complications

For any model yielding a conclusion C, one can construct a statistically equivalent model that refutes C and fits the data equally well. – Judea Pearl

Causal inference is necessary and possible, but it is not perfect and, most importantly, it requires domain knowledge. – Samantha Kleinberg

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More Possibilities

- Structural Causal Models (SCM)

- Bayesian Structural Time Series (BSTS)

- Machine Learning (e.g. Deep Learning)

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Thank you

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