Eco-feedback and incentive mechanism design for multi-residential building

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Project Description

Goal: The development of an energy management tool for multi-unit residential buildings that encourages energy conservative behaviors among residents.
- Actionable feedback design using programable thermostat
- Incentive mechanism design

Approach

- Collect baseline energy consumption and thermostat data from a 50 unit multi-residential building located in Indianapolis.
- Design a simple evaluation matrix that easily describes occupants' baseline behavior in terms of energy conservation.
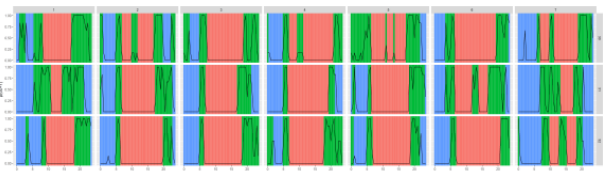- Develop a game theoretic model that provides optimal incentives.

Discussion

Occupant behaviors are evaluated during the three states of occupancy Home/Away/Sleep.
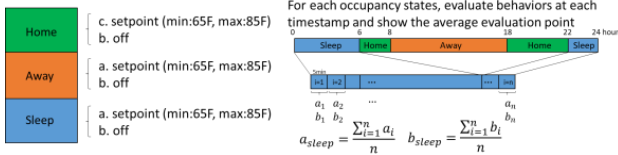- Applied rule-based occupancy state classification.
- Evaluated setpoint control and thermostat off actions.
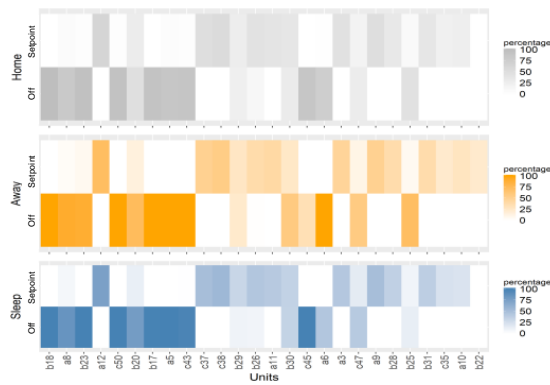
Results

1. Occupancy state detection

2. Evaluation

Home	c. setpoint (min:65F, max:85F) / b. off
Away	a. setpoint (min:65F, max:85F) / b. off
Sleep	a. setpoint (min:65F, max:85F) / b. off

For each occupancy states, evaluate behaviors at each timestamp and show the average evaluation point

$$a_{sleep} = \frac{\sum_{i=1}^{n} a_i}{n} \quad b_{sleep} = \frac{\sum_{i=1}^{n} b_i}{n}$$

3. Evaluation result

Customized information and actionable feedback is required to change the behaviors of occupants in residential house.

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