Using SAS® and JMP ® to Monitor Energy Conservation Efforts

John Mills and Sarah Thornton

Progress Energy, Raleigh North Carolina

john.mills@pgnmail.com   sarah.thornton@pgnmail.com

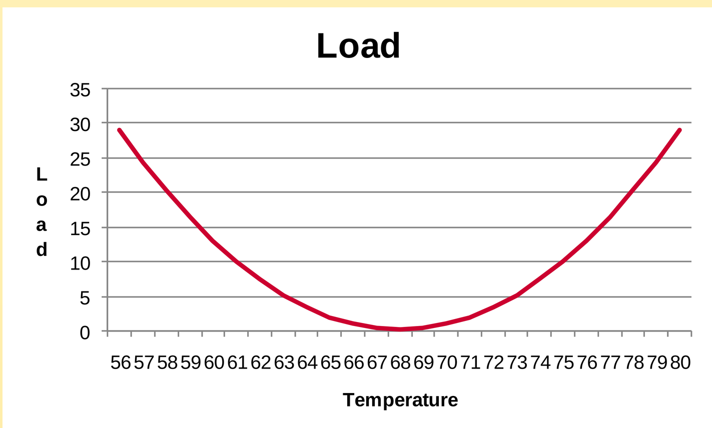
Background:

Progress Energy is not only committed to keeping our customer's electricity reliable and affordable, but we are also committed to keeping our earth clean and healthy, and the economy growing.

For this reason Progress Energy encourages customers' participation in energy efficiency programs. These programs offer simple solutions to help customers decrease their electricity usage without sacrificing home comfort.

Business Problem:

Progress Energy's Free Customized Home Energy Check is an option for customers to receive a free detailed breakdown of their home energy usage, energy saving tips specific to their home, and recommendations for low and no cost changes to improve their home's energy efficiency. The problem with which our group was faced was determining how much, if any savings the company was receiving by supplying customers with this useful tool. The key concept is HVAC load. More efficient homes have a flatter curve. (Temperature has less effect on a well insulated home.) We were able to use JMP to explore different regression options easily, and to visibly see our regression begin to predict customer savings with improved accuracy. Using these estimates, we could attempt to predict if customers were implementing advice given at the energy audit, thus improving the efficiency of their homes.



Engineering Model:

Weather driven use is a function of Load (f(load)). The Regression model is used to estimate the sensitivity of energy use to Load before and after the Energy Audit. The values of b before and after DSM audit are used to calculate energy savings.

Engineering Model:

$Y_0=a_0+b_0(load)$ $Y_1=a_1+b_1(load)$

Y_0= kWh pre-audit Y_1= kWh post-audit

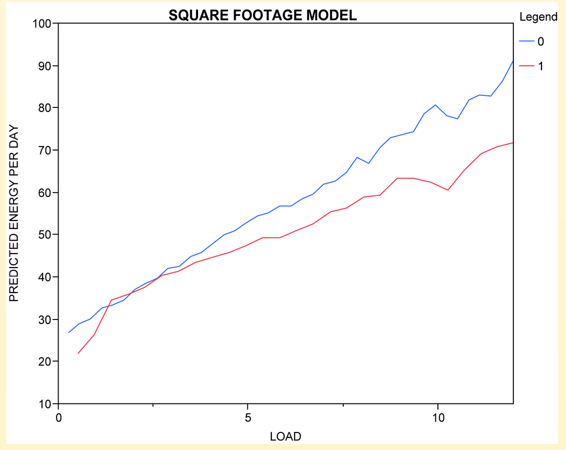
a= plug load

b= efficiency of home due to heating/cooling load

Positive Savings if $Y_1 - Y_0 < 0$

More efficient if $b_1 - b_0 < 0$

Square footage model:



By adding square footage, which was collected from home energy checks, we were able to increase the accuracy of our model.

Square footage model:

$Y_0=a_0+b_0(load)+c_0(ft^2)$

$Y_1=a_1+b_1(load)+c_1(ft^2)$

Y_0= kWh pre-audit Y_1= kWh post-audit

a= plug load

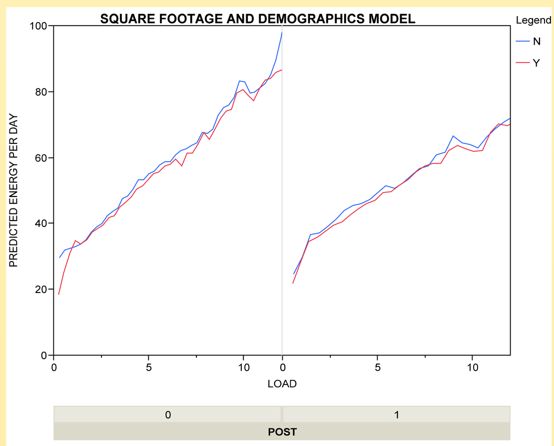
b= efficiency of home due to heating/cooling load

c= impact of square footage of home

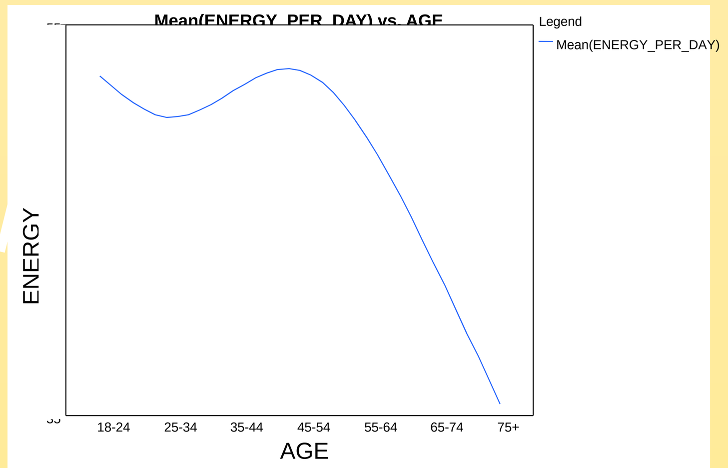
Positive Savings if $Y_1 - Y_0 < 0$

Adding Demographics:

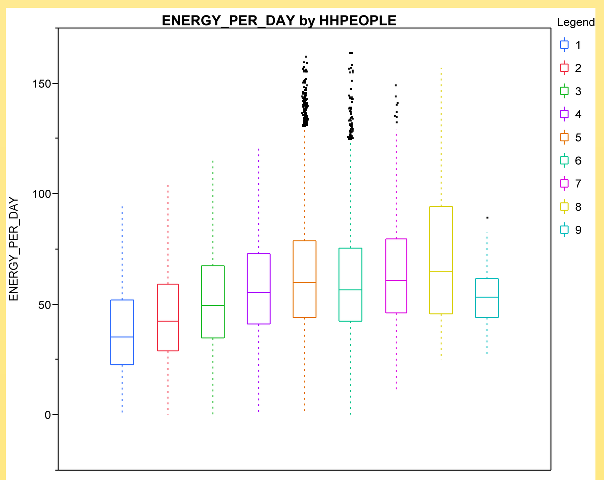
We observed a difference when comparing customers who are enrolled in our load control program, and those who are not enrolled.



We also we able to see that there was a relationship between Head of Household age, and the average amount of Energy used per day.



A relationship between the number of people in the household and the average amount of energy consumed per day was also noted.



After observing relationships between various demographic variables and the customer's energy usage. We tested these demographic variables in the model.

Demographic model:

$Y_0=a_0+b_0(load)+c_0(ft^2) + d_0D$

$Y_1=a_1+b_1(load)+c_1(ft^2) + d_1D$

Y_0= kWh pre-audit Y_1= kWh post-audit

a= plug load

b= efficiency of home due to heating/cooling load

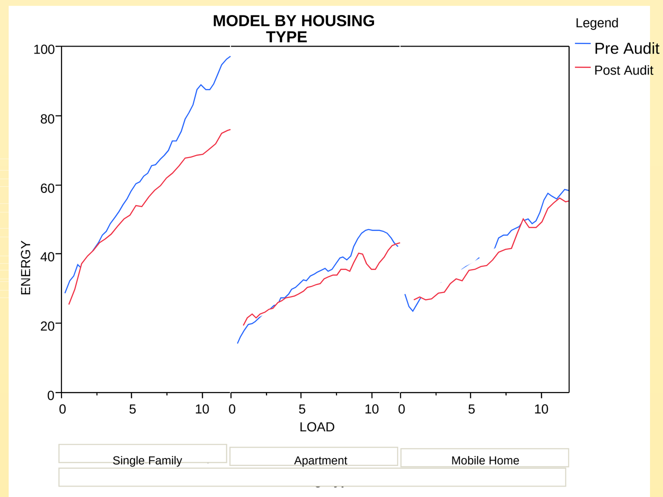
c= impact of square footage of home

d= impact of demographic values (head of household age, number of people, load control participation)

Positive Savings if $Y_1 - Y_0 < 0$

Breakdown by Housing Type:

Because there are so many differences in the way single family homes, apartments and mobile homes are insulated, cooled, and heated, our final step in revising this model was separating out the models by housing type.



The table below displays value for Load **coefficients** for each housing type as a separate model. Note the changes in slope before and after the home's audit.

Housing Type	Pre-Audit	Post-Audit
Single Family	6.2458	3.8977
Apartment	3.2410	2.300
Mobile Home	2.4156	2.5458
Combined	5.8753	3.8870

Further Recommendations and Conclusions:

A usable model has been constructed. We created flexible input options for Engineers to change variables if needed. The impacts of the Energy Efficiency Audits are observable, but there is variation between demographic groups. Next steps will be to further explore new methods of analysis.

Model	Pre-Audit	Post-Audit
Engineering	0.0184	0.1366
Square Footage	0.2819	0.2691
Demographics	0.3544	0.3422