

#### Case 4: Demand Variation from Usage, Vacancies and Demand Spikes

The final model of consumer behavior includes randomness in the peak/usage relationship across consumers as well as some of the antidotes recited in the ComEd study. Other factors included in the model represent vacation homes and vacancies in apartments and other residents. Vacation homes are modeled by including a random dummy variable in .5% of the simulations where there the average usage during the year is reduced by 90% but the peak demand remains the same. Vacancies are modeled by reducing the peak demand and holding usage at the same level. This is assumed to occur in 3% of the cases and cause an 80% reduction in demand. The consumer behavior can be represented by the following model:

$$\text{Demand} = \text{Usage} \times (\text{Usage Coefficient} \times \text{Random Factor})$$

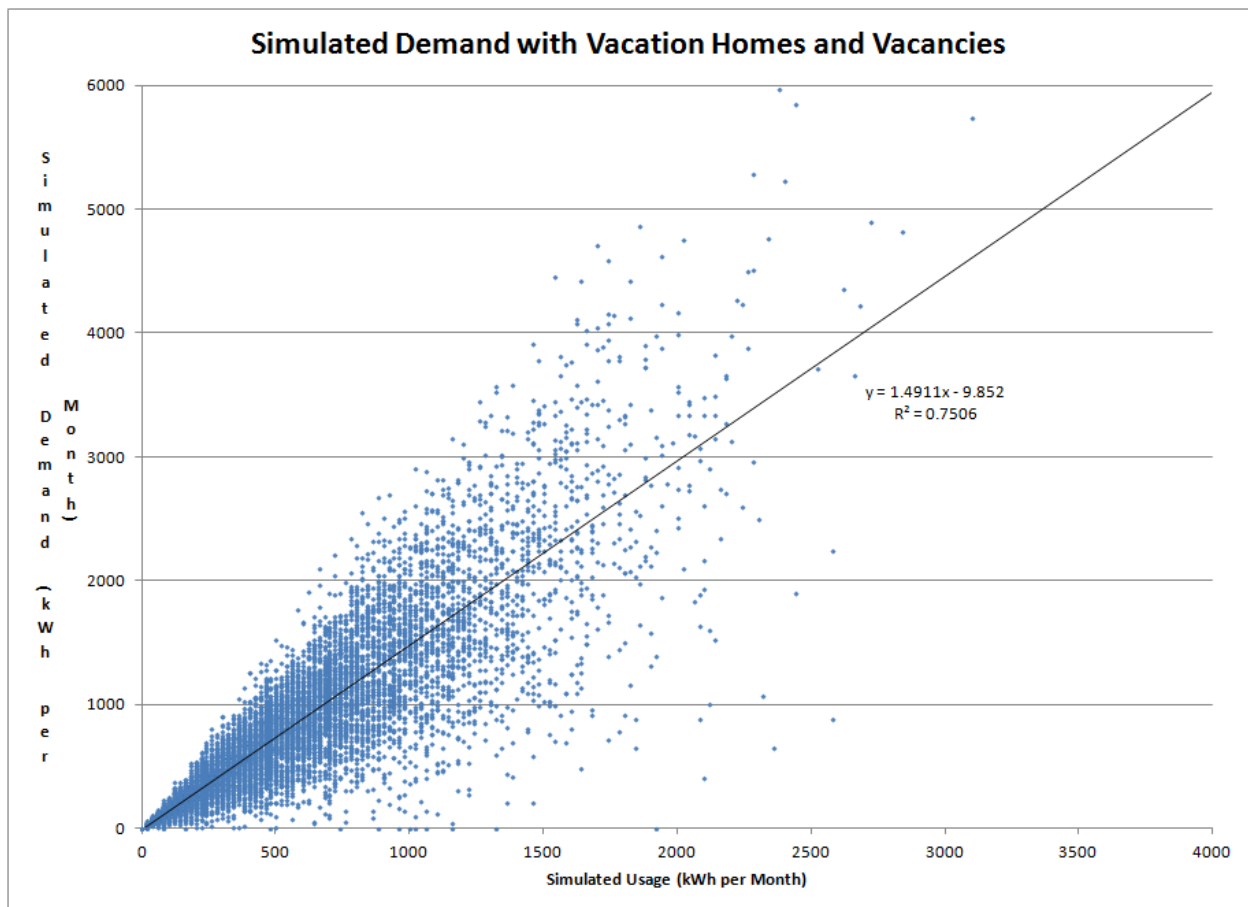
Where:

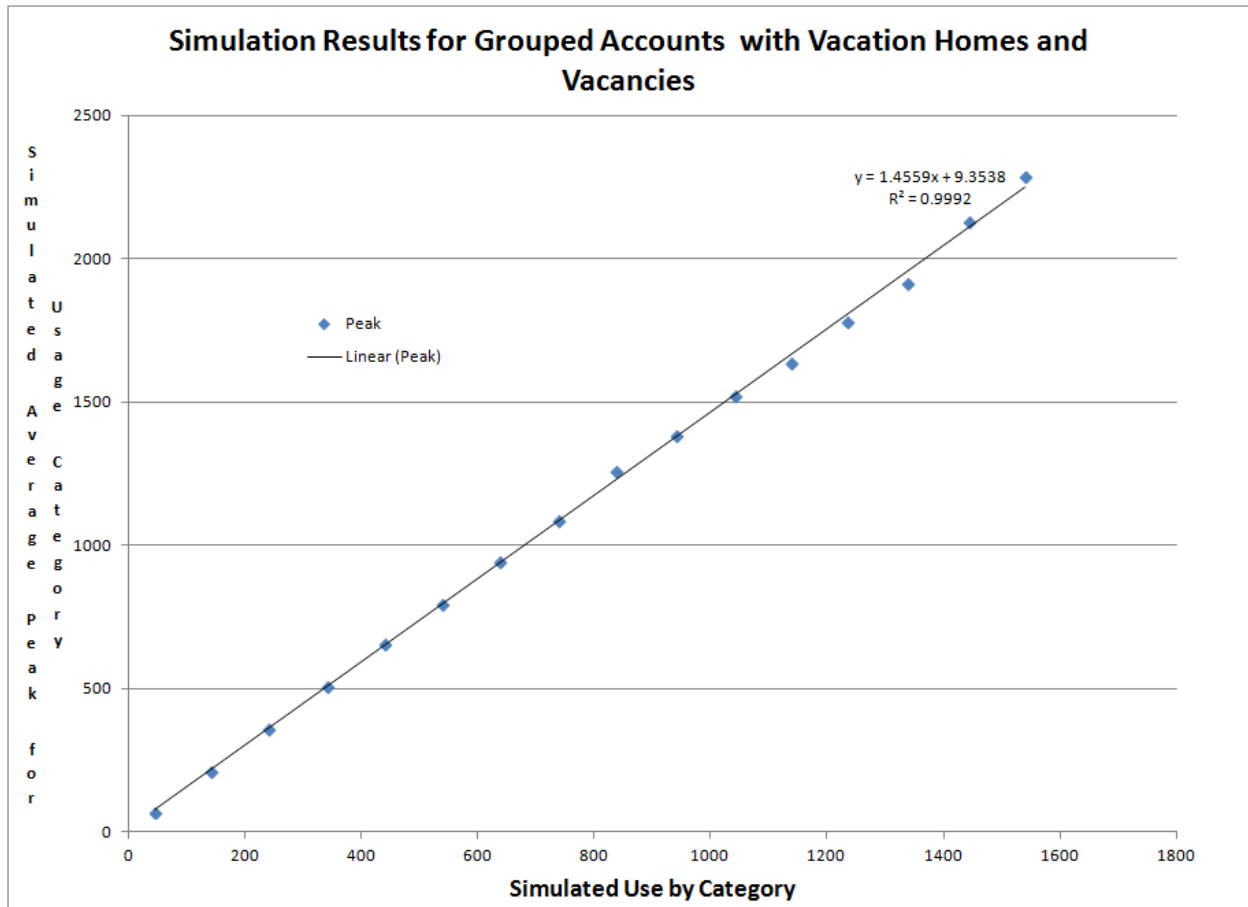
$$\text{Usage} = \text{Base Usage} - .9 \text{ Usage} \times \text{Random Variable for Vacation}$$

And:

$$\text{Demand} = \text{Base Demand} - .7 \times \text{Random Variable for Vacancies}$$

Results of this case are similar to the third case and to the actual data. There is somewhat more variation in the scatter plots of individual consumers, but this variation is eliminated once the consumer groups are aggregated. Importantly, the inclusion of vacation homes and vacancies does not create an intercept term that is different from zero. This implies that vacation homes and vacancies do not create an argument for assuming that a portion of demand is associated with the existence of a consumer account.





### Part 3: Load Research Data to Evaluate Peak Demand in Single Hours Relative to Average Use over the Year

In the final part of the analysis, detailed load research data for 2012 is used rather than the billing data for 2010. As with the billing data used in part 1, the analysis is only made for non-space heat consumers. Advantages of using the load research data is that it can evaluate single peak hours of demand rather than the average monthly demand used in the first section. In addition, the load research data can be used to measure load factors for various regions because the data includes zip codes. Disadvantages of using the load research data are that it includes far fewer consumers and there are problems with both the quality of the data and the representativeness of the sample.

In addition to using the load research data for evaluating ComEd's Residential Usage Study, review of the data can be used for other objectives. First, since the load research data is used as a driver in allocating loads across customer classes, problems with the data can have much larger implications than simply evaluating the use/load relationship. Second, as the load

research data includes zip codes, the data can be used to evaluate the efficiency of use inside the City of Chicago and outside the City of Chicago.

### **Problems with Load Research Data**

The load research data compiles hourly loads for a relatively small sample of consumers. As normal residential meters cannot tabulate hourly loads, the meters from the selected sample are used to compute the peak load for the entire residential class. If errors are made in the sample, then the results of the entire cost of service study are suspect.

In reviewing the load research data a few problems became apparent:

1. The data contained many missing values where there were no recordings for weeks at a time.
2. Many of the meter readings appeared to be simply repeated rather than constituting the expected time pattern of loads.
3. The sample of consumers was skewed in favor of high use ratepayers. As the high use ratepayers have worse load factors, this bias increases cost allocation to the residential class. The graph below that compares the distribution of load research to actual by usage increment demonstrates that the categories of 50 – 300 kWh are dramatically represented. These consumers tend to have the highest load factors.
4. The sample of consumers was skewed against consumers in the City of Chicago. As the City has a better load factor than other regions, this also creates a bias that increases cost allocation to the overall residential class.
5. The multi-family sample appears to use multiple accounts from a single building meaning that the sample is not really random.

A few of the problems with ComEd's load research data are presented below. The first figure is a picture of one of the accounts with blank data for some of the days.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
53	14159589.97	60441	19-Feb-12	FALSE	1.00	50.00	366.00	1.00	0.15	0.14	0.15	0.17	0.16	0.17	0.1	0.17
54	14159589.97	60441	20-Feb-12	FALSE	1.00	51.00	366.00	1.00	0.19	0.17	0.1	0.17	0.18	0.18	0.18	0.18
55	14159589.97	60441	21-Feb-12	FALSE	1.00	52.00	366.00	1.00	0.17	0.16	0.15	0.15	0.15	0.15	0.16	0.15
56	14159589.97	60441	22-Feb-12	FALSE	1.00	53.00	366.00	1.00	0.18	0.16	0.15	0.15	0.08	0.16	0.16	0.16
57	14159589.97	60441	23-Feb-12	FALSE	1.00	54.00	366.00	1.00	0.1	0.15	0.15	0.16	0.16	0.16	0.16	0.16
58	14159589.97	60441	24-Feb-12	FALSE	1.00	55.00	366.00	1.00	0.17	0.15	0.15	0.15	0.15	0.15	0.08	0.16
59	14159589.97	60441	25-Feb-12	FALSE	1.00	56.00	366.00	1.00	0.18	0.17	0.1	0.18	0.17	0.18	0.18	0.18
60	14159589.97	60441	26-Feb-12	FALSE	1.00	57.00	366.00	1.00	0.2	0.18	0.18	0.18	0.18	0.18	0.18	0.19
61	14159589.97	60441	27-Feb-12	FALSE	1.00	58.00	366.00	1.00	0.17	0.15	0.15	0.15	0.08	0.16	0.16	0.17
62	14159589.97	60441	28-Feb-12	FALSE	1.00	59.00	366.00	1.00	0.12	0.17	0.17	0.18	0.18	0.17	0.17	0.18
63	14159589.97	60441	29-Feb-12	FALSE	1.00	60.00	366.00	1.00	0.16	0.15	0.14	0.14	0.15	0.14	0.07	0.14
64	14159589.97	60441	1-Mar-12			61.00	366.00	1.00								
65	14159589.97	60441	2-Mar-12			62.00	366.00	1.00								
66	14159589.97	60441	3-Mar-12			63.00	366.00	1.00								
67	14159589.97	60441	4-Mar-12			64.00	366.00	1.00								
68	14159589.97	60441	5-Mar-12			65.00	366.00	1.00								
69	14159589.97	60441	6-Mar-12			66.00	366.00	1.00								
70	14159589.97	60441	7-Mar-12			67.00	366.00	1.00								
71	14159589.97	60441	8-Mar-12			68.00	366.00	1.00								
72	14159589.97	60441	9-Mar-12			69.00	366.00	1.00								
73	14159589.97	60441	10-Mar-12			70.00	366.00	1.00								
74	14159589.97	60441	11-Mar-12			71.00	366.00	1.00								
75	14159589.97	60441	12-Mar-12	FALSE	12.00	72.00	366.00	1.00	0.71	0.68	0.63	0.72	0.74	0.68	0.63	0.64
76	14159589.97	60441	13-Mar-12	FALSE	1.00	73.00	366.00	1.00	0.45	0.38	0.38	0.38	0.38	0.3	0.45	0.55
77	14159589.97	60441	14-Mar-12	FALSE	1.00	74.00	366.00	1.00	0.38	0.29	0.33	0.33	0.34	0.47	0.65	0.54

The second figure is an example of where hourly data seemed to be repeated.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
854	27353395.28	61364	28-Apr-12	FALSE	1.00	119.00	366.00	3.00	0.35	0.24	0.26	0.3	0.37	0.27	0.27	0.25
855	27353395.28	61364	29-Apr-12	FALSE	1.00	120.00	366.00	3.00	0.31	0.37	0.28	0.27	0.28	0.39	0.25	0.24
856	27353395.28	61364	30-Apr-12	FALSE	1.00	121.00	366.00	3.00	0.27	0.35	0.33	0.28	0.28	0.38	0.3	0.25
857	27353395.28	61364	1-May-12	FALSE	1.00	122.00	366.00	3.00	0.29	0.25	0.3	0.36	0.25	0.25	0.35	0.25
858	27353395.28	61364	2-May-12	FALSE	1.00	123.00	366.00	3.00	0.26	0.29	0.37	0.26	0.28	0.38	0.23	0.22
859	27353395.28	61364	3-May-12	FALSE	1.00	124.00	366.00	3.00	0.31	0.28	0.24	0.36	0.23	0.29	0.31	0.22
860	27353395.28	61364	4-May-12	FALSE	1.00	125.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
861	27353395.28	61364	5-May-12	FALSE	1.00	126.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
862	27353395.28	61364	6-May-12	FALSE	1.00	127.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
863	27353395.28	61364	7-May-12	FALSE	1.00	128.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
864	27353395.28	61364	8-May-12	FALSE	1.00	129.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
865	27353395.28	61364	9-May-12	FALSE	1.00	130.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
866	27353395.28	61364	10-May-12	FALSE	1.00	131.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
867	27353395.28	61364	11-May-12	FALSE	1.00	132.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
868	27353395.28	61364	12-May-12	FALSE	1.00	133.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
869	27353395.28	61364	13-May-12	FALSE	1.00	134.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
870	27353395.28	61364	14-May-12	FALSE	1.00	135.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
871	27353395.28	61364	15-May-12	FALSE	1.00	136.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
872	27353395.28	61364	16-May-12	FALSE	1.00	137.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
873	27353395.28	61364	17-May-12	FALSE	1.00	138.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
874	27353395.28	61364	18-May-12	FALSE	1.00	139.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
875	27353395.28	61364	19-May-12	FALSE	1.00	140.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
876	27353395.28	61364	20-May-12	FALSE	1.00	141.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
877	27353395.28	61364	21-May-12	FALSE	1.00	142.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
878	27353395.28	61364	22-May-12	FALSE	1.00	143.00	366.00	3.00	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34