Residential Vacancy Rate

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Outline

- Objective
- Potential Methods
- Model Assumptions
- Data Models
- Results
- Conclusions

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Objective

Goal: To better understand the changing behavior of residential monthly revenue.

$$Vacancy\ Rate_m = \left[\frac{\text{Number of Vacant Premise}_m}{\text{Number of All Premise}_m} \right] * 100,$$

where m is the target month.

** Examples will be given on calculating **Jan 2007** residential vacancy rate.*

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Potential Methods

I. U.S. Census Bureau statistics
   - Housing and Rental Vacancy Rate

II. Simple Procedure
   - Monthly kWh is under a certain cut-off kWh

III. Mathematical model
   - Monthly kWh has a significant decrease compared to an estimated prediction(or a baseline)
   - Monthly kWh is under a certain cut-off kWh

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Method III – Model Assumptions

A premise is **vacant** if it meets two criteria.

First criterion: a **significant** kWh drop as

$$kWh_m \leq 40\% * \widehat{kWh}_m$$

Second criterion: below a **cut-off** kWh

$$kWh_m \leq 50\% * AvgkWh_m$$

where $\widehat{kWh}_m$ is a model prediction representing a baseline of 'normal' billing usage and $AvgkWh_m$ is the average monthly kWh of predefined groups.

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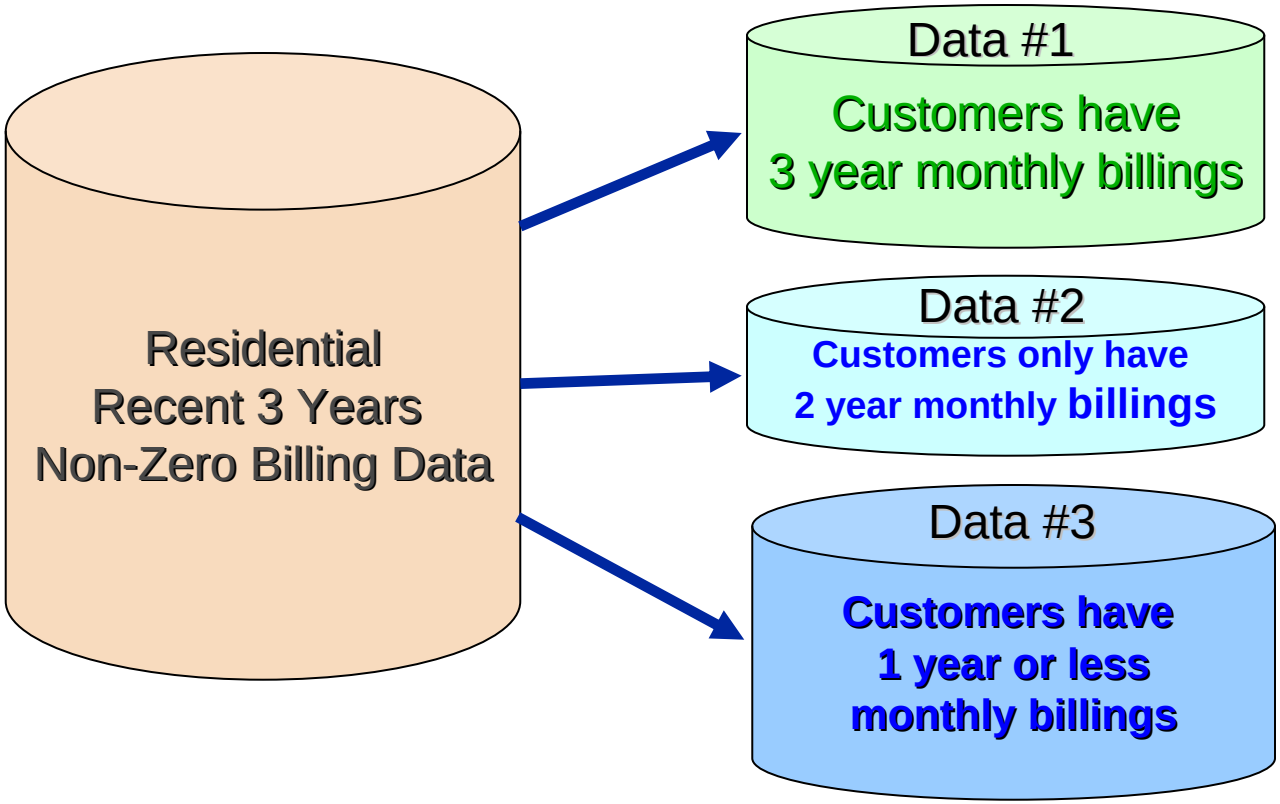
Method III – Data Structure



* Zero kWh bills are counted as vacant.

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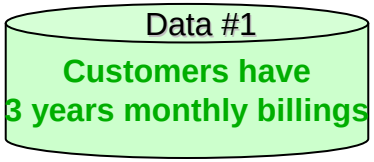
Data Model #1



- **Input data:** 3 year monthly billings for the target month
- **Baseline calculation:**

  - define $\min kWh$ and $\max kWh$ as the minimum and maximum out of $kWh05, kwh06$ and $kwh07$ respectively

  - If $\min kWh > 40\% * \max kWh$, then

$$\widehat{kWh}_m = average\left(kWh05_m + kWh06_m + kWh07_m\right).$$

  - If $\min kWh \le 40\% * \max kWh$, then

$$\widehat{kWh}_m = \frac{\left(kWh05_m + kWh06_m + kWh07_m - \min kWh\right)}{2}.$$

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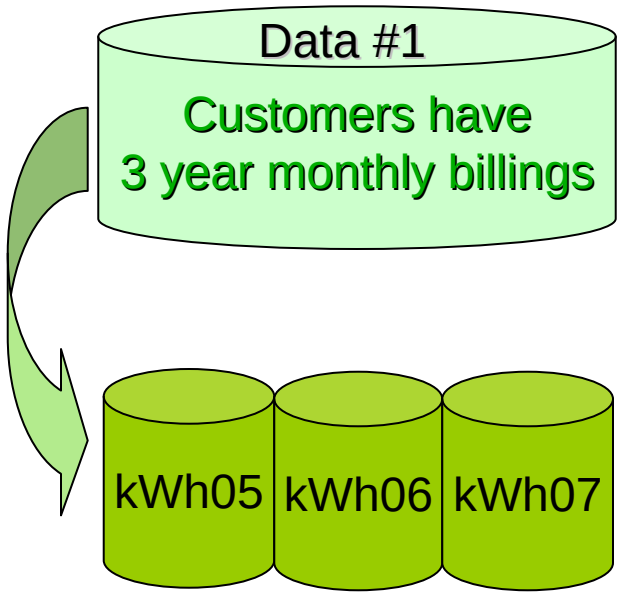
Data Model #1



$$\widehat{kWh}_m = average\left(kWh05_m + kWh06_m + kWh07_m\right).$$

or

$$\widehat{kWh}_m = \frac{\left(kWh05_m + kWh06_m + kWh07_m - \min kWh\right)}{2}.$$

Premise	kWh05	kWh06	kWh07
# a	200	208	139
# b	150	320	80
.			
.			
.			

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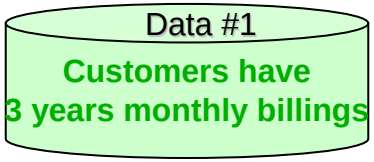
Data Model #1 - Example



Premise	2005 Jan (kWh)	2006 Jan (kWh)	2007 Jan (kWh)	40%* max kWh	min kWh >40%* max kWh	$\widehat{kWh}_{Jan}$ (baseline)	40%* $\widehat{kWh}_{Jan}$	Meet 1st Criterion?
# a	200	208	139	83.2	Yes	182.3	72.9	No
# b	150	320	80	128	No	235	94	Yes

Baseline Calculations:

$$\widehat{kWh}_{Jan} = \frac{200 + 208 + 139}{3} = 182.3$$

$$\widehat{kWh}_{Jan} = \frac{150 + 320}{2} = 235$$

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Data Model #2

Data #2
Customers only have 2 year monthly billings

- **Input data:** 2 year monthly billings for the target month
- **Baseline calculation:**

$$\widehat{kWh}_m = kWh05_m$$

or

$$\widehat{kWh}_m = kWh06_m$$

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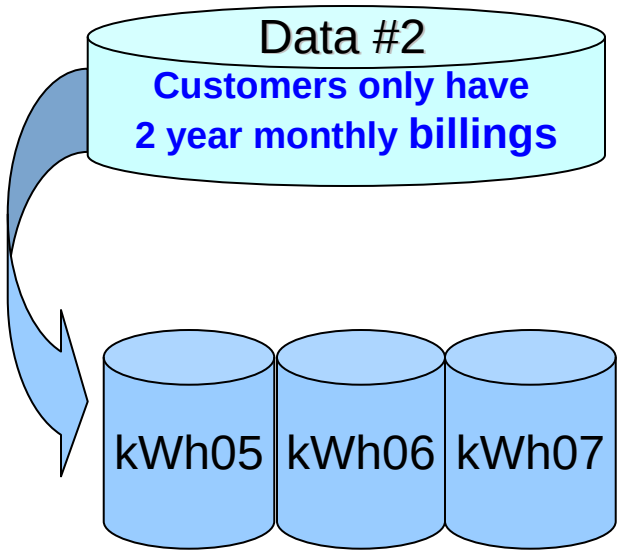
Data Model #2



$$\widehat{kWh}_m = kWh05_m$$

or

$$\widehat{kWh}_m = kWh06_m$$

Premise	kWh05	kWh06	kWh07
# c	300	.	269
# d	.	1528	589
.			
.			
.			

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Data Model #2

Data #2
Customers only have 2 year monthly billings

Premise	2005 Jan (kWh)	2006 Jan (kWh)	2007 Jan (kWh)	$\widehat{kWh}_{Jan}$ (baseline)	40%* $\widehat{kWh}_{Jan}$	Meet 1st Criterion?
# c	300	N/A	269	300	120	No
# d	N/A	1,528	589	1,528	611.2	Yes

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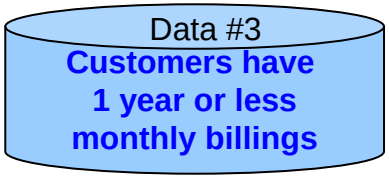
Data Model #3



- **Input data:** customers have 1 year or less monthly billings

- **Baseline calculation:**

$$\widehat{kWh}_m = \frac{\text{Individual maximum kWh of last 12 months}}{\text{Group average kWh at the individual max month}} \times \text{Group average kWh for target month}$$

R_{WIN} : the winter average usage is 20% higher than the summer average;
R_{SUM} : the winter average usage 60% of the summer average;
R_{MID} : customers are not grouped in either **R_{WIN}** or **R_{SUM}**

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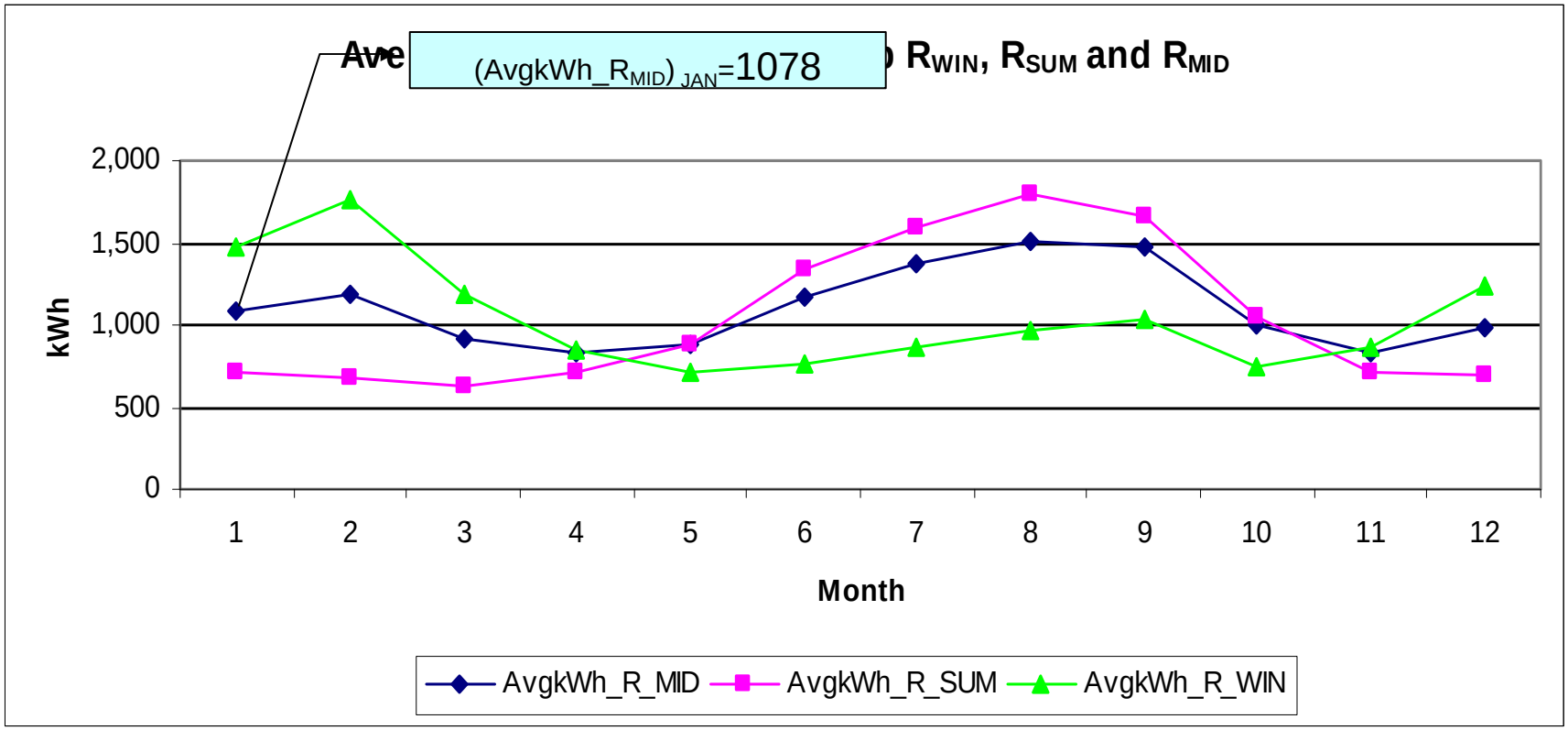
Data #3
Customers have 1 year or less monthly billings

Groups' Average Monthly kWh



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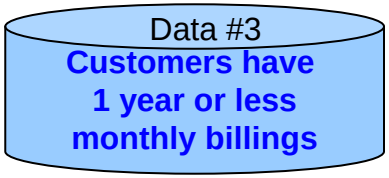

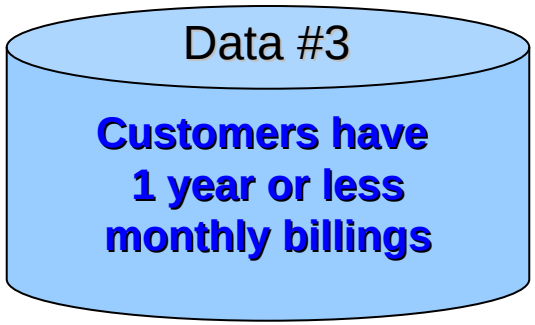

$$\widehat{kWh}_m = ratio \times (\text{group average } kWh_m)$$

where,

$$ratio = \frac{MaxkWh}{\text{Groupe } Avg\_kWh_{\max \text{ month}}}$$

Premise #	year	month	kWh
e	2006	02	100
	2006	03	90
	2006	04	146
	.		
	.		
	.		
	2007	01	329

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Data Model #3

Month	kWh of premise # e	AvgkWh_R_{WIN}	$\widehat{KWH}_m$	40%* $\widehat{KWH}_m$	Meet 1st Criterion?
200602	100	1,134	318.7	127.5	Yes
200603	90	1,105	310.5	124.2	Yes
200604	160	905	254.3	101.7	No
200605	150	854	240	96	No
200606	270	1,020	286.6	114.6	No
200607	350	1,534	431.1	172.4	No
200608	**360**	**1,282**	360.2	144.1	No
200609	280	1,307	367.3	146.9	No
200610	200	933	261.2	104.5	No
200611	255	909	255.4	102.2	No
200612	310	1,160	326	130.4	No
200701	**329**	1,327	372.6	149	No

Baseline Calculation: $\widehat{kWh}_1 = \frac{360}{1282} \times 1327 = 372.6$

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Vacant Criteria

First Criterion: a significant billing usage drop?

$$kWh_m \leq 40\% * \widehat{kWh}_m$$

Second Criterion: under a chosen cut-off value?

$$kWh_m \leq 50\% * AvgkWh_m \ ?$$

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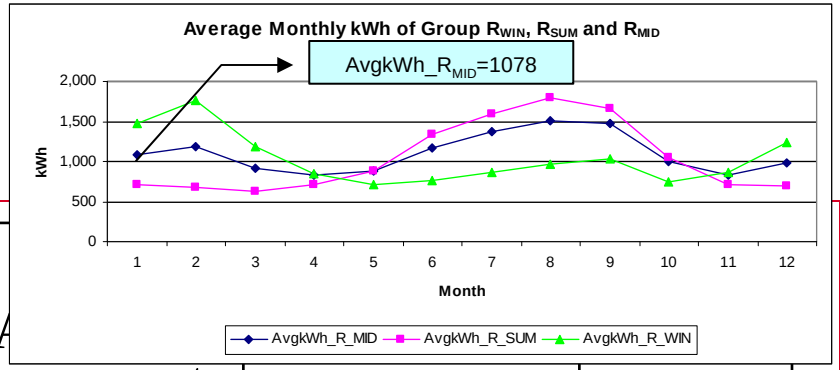
Examples



Data Model/ premise	2007 Jan (kWh)	40%* Baseline	Meet First Criterion	A of Groups		
M1_a	139	72.8	No	539	Yes	No
M1_b	80	94	Yes	539	Yes	Yes
M2_c	269	120	No	352.5	Yes	No
M2_d	589	611.2	Yes	733	No	No
M3_e	329	149.2	No	733	Yes	No

Note: 50%*(AvgkWh_R_{MID})$_{JAN}$=50%*1078=539 for Jan 2007.

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Conclusions

- Vacancy Rate can be useful to explain revenue loss.

- Model provides a close estimate of residential vacancy rate compared to U.S. Census Bureau statistics.

- Estimates can be bias due to
  - Thresholds of cut-off values
  - Data quality
  - Cases that might not be covered, i.e. cancel/re-bills, energy usage behavior changes, etc.

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Thank you !

Questions?

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