

# DOE Technical Assistance Program

U.S. DEPARTMENT OF  
**ENERGY** | Energy Efficiency &  
Renewable Energy



The Parker Ranch installation in Hawaii

## Integrating Experimental Design Into Your Program

August 24, 2011

# What is TAP?

DOE's Technical Assistance Program (TAP) supports the Energy Efficiency and Conservation Block Grant Program (EECBG) and the State Energy Program (SEP) by providing state, local, and tribal officials the tools and resources needed to implement successful and sustainable clean energy programs.



## TAP offers:

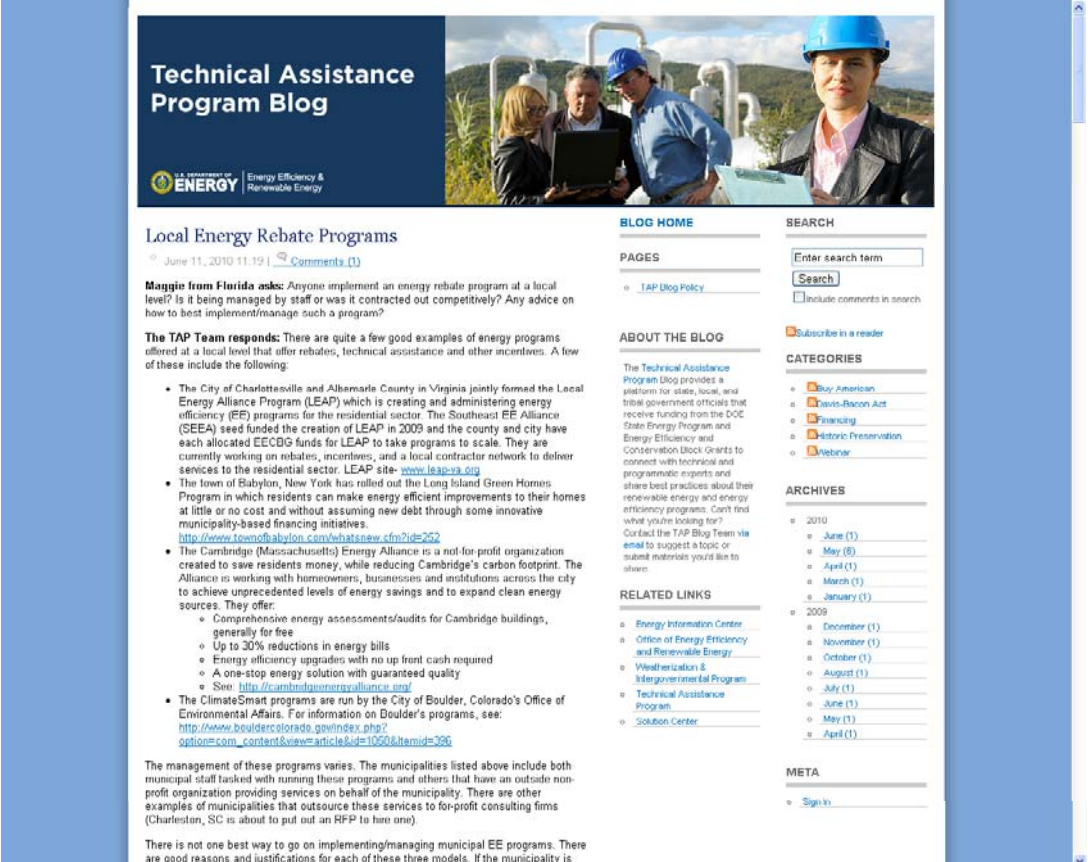
- One-on-one assistance
- Extensive online resource library, including:
  - Webinars
  - Events calendar
  - TAP Blog
  - Best practices and project resources
- Facilitation of peer exchange

## On topics including:

- Energy efficiency and renewable energy technologies
- Program design and implementation
- Financing
- Performance contracting
- State and local capacity building

Access the TAP Blog!  
<http://www.eereblogs.energy.gov/tap/>

Provides a platform for state, local, and tribal government officials and DOE's network of technical and programmatic experts to connect and share best practices on a variety of topics.



**Technical Assistance Program Blog**

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

### Local Energy Rebate Programs

June 11, 2010 11:19 | Comments (1)

**Maggie from Florida asks:** Anyone implement an energy rebate program at a local level? Is it being managed by staff or was it contracted out competitively? Any advice on how to best implement/manage such a program?

**The TAP Team responds:** There are quite a few good examples of energy programs offered at a local level that offer rebates, technical assistance and other incentives. A few of these include the following:

- The City of Charlottesville and Albemarle County in Virginia jointly formed the Local Energy Alliance Program (LEAP) which is creating and administering energy efficiency (EE) programs for the residential sector. The Southeast EE Alliance (SEEA) seed funded the creation of LEAP in 2009 and the county and city have each allocated EECBG funds for LEAP to take programs to scale. They are currently working on rebates, incentives, and a local contractor network to deliver services to the residential sector. LEAP site: [www.leap-va.org](http://www.leap-va.org)
- The town of Babylon, New York has rolled out the Long Island Green Homes Program in which residents can make energy efficient improvements to their homes at little or no cost and without assuming new debt through some innovative municipality-based financing initiatives. <http://www.townofbabylon.com/subsites/new.cfm?id=252>
- The Cambridge (Massachusetts) Energy Alliance is a not-for-profit organization created to save residents money, while reducing Cambridge's carbon footprint. The Alliance is working with homeowners, businesses and institutions across the city to achieve unprecedented levels of energy savings and to expand clean energy sources. They offer:
  - Comprehensive energy assessments/audits for Cambridge buildings, generally for free
  - Up to 30% reductions in energy bills
  - Energy efficiency upgrades with no up front cash required
  - A one-stop energy solution with guaranteed quality
  - See <http://www.cambridgeenergyalliance.org/>
- The ClimateSmart programs are run by the City of Boulder, Colorado's Office of Environmental Affairs. For information on Boulder's programs, see: [http://www.bouldercolorado.gov/index.php?option=com\\_content&view=article&id=1050&Itemid=386](http://www.bouldercolorado.gov/index.php?option=com_content&view=article&id=1050&Itemid=386)

The management of these programs varies. The municipalities listed above include both municipal staff tasked with running these programs and others that have an outside non-profit organization providing services on behalf of the municipality. There are other examples of municipalities that outsource these services to for-profit consulting firms (Charleston, SC is about to put out an RFP to hire one).

There is not one best way to go on implementing/managing municipal EE programs. There are good reasons and justifications for each of these three models. If the municipality is

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- TAP Blog Policy

**ABOUT THE BLOG**

The Technical Assistance Program Blog provides a platform for state, local, and tribal government officials that receive funding from the DOE State Energy Program and Energy Efficiency and Conservation Block Grants to connect with technical and programmatic experts and share best practices about their renewable energy and energy efficiency programs. Can't find what you're looking for? Contact the TAP Blog Team via email to suggest a topic or submit materials you'd like to share.

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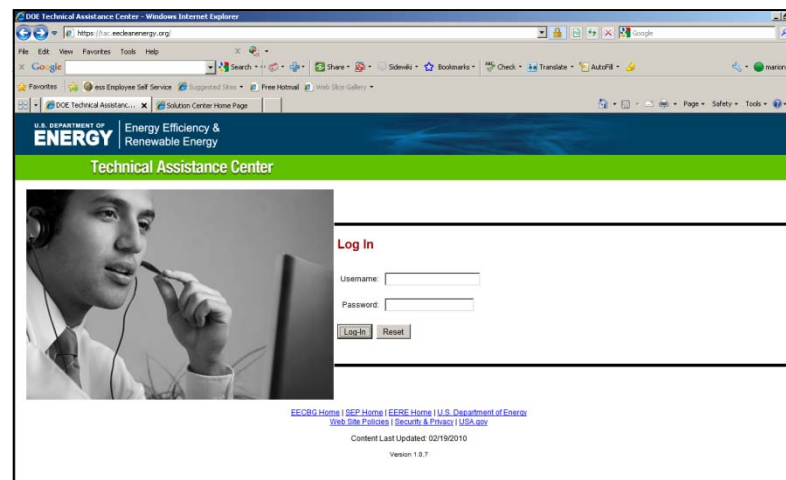
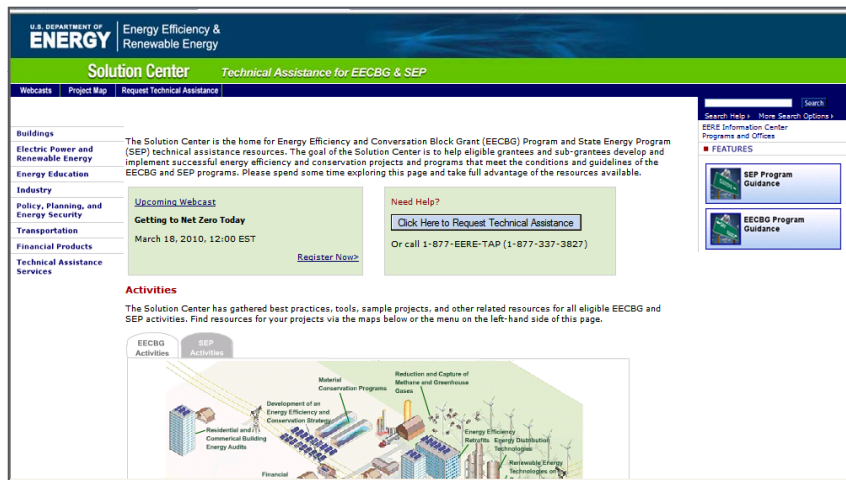
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We encourage you to:

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via the [Solution Center](#)

2) Submit a request via the  
[Technical Assistance Center](#)



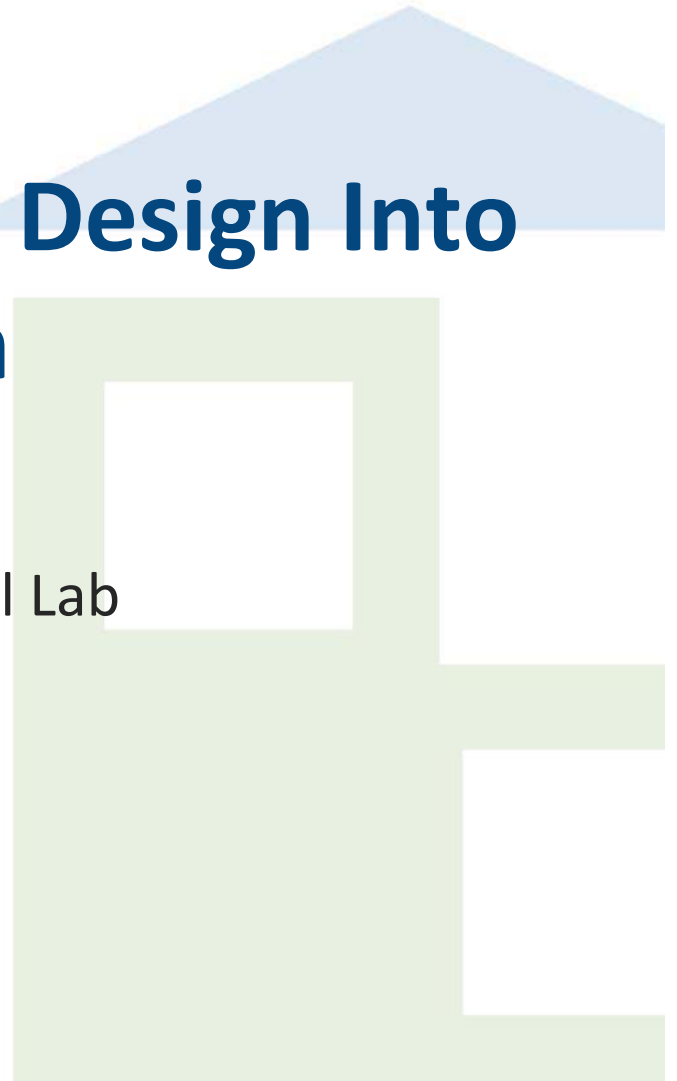
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[solutioncenter@ee.doe.gov](mailto:solutioncenter@ee.doe.gov)



# Integrating Experimental Design Into Your Program

Lawrence Berkeley National Lab

August 2011





# Summary

- **Why experimental design?**
- Questions experimental design can answer (with guest speakers)
- Light number crunching
- Extensions





# Why Experimental Design?

**Main Question: Is this program as successful, as cost effective as it could be?**

- **Problem:** We don't get to observe what would have happened in alternate universes (with slightly different program designs)
- **Solution:** Randomized, controlled experiments are the next best thing
  - Create two different randomly chosen groups, give each group a slightly different program design, then compare
  - **If people are placed into the two groups randomly** and there are enough people so that differences between people average out, **then any difference in outcomes in the two groups must be due to differences in the programs** (different groups are like alternate universes) → the difference in program design **caused** the difference in outcomes







# Why Experimental Design?

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  - Create two different randomly chosen groups, give each group a slightly different program design, then compare
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# Summary

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## But First - 3 Basic Skills

- #1: How to Randomize Households
- #2: How to Measure
- #3: How to Evaluate

st



# Basic Skill #1: How to Randomize Households

=RAND()

= IF(B2<AVERAGE(B\$2:B\$100),"A","B")

List of households

	B	C
Household	Random Number	Group
1		
2 603 Brookside, Oakland	0.053020766	A
3 791 Alvarado Rd, Oakland	0.660021598	B
4 9426 23rd St, Oakland	0.145947541	A
5 462 College Ave, Oakland	0.027250358	A
6 927 Broadway #2, Oakland	0.23746579	A
7 1023 Telegraph Ave, Oakland	0.731771824	B
8 3144 Claremont Ave, Oakland	0.896392581	B
9 53 Tunnel Rd, Oakland	0.905371379	B
10 284 Piedmont Ave, Oakland	0.043614657	A
11 423A Shattuck Ave, Oakland	0.055732332	A
...	...	...
199 927 W MacArthur Blvd, Oakland	0.676906765	B
200 59 Chabot Rd #2B, Oakland	0.816688066	B
201		
202		

# Basic Skill #1: How to Randomize Households

	A	C	D
	Household	Group	
1			
2	603 Brookside, Oakland	A	
3	391 Alvarado Rd, Oakland	B	
4	5426 23rd St, Oakland	A	
5	462 College Ave, Oakland	A	
6	927 Broadway #2, Oakland	A	
7	1023 Telegraph Ave, Oakland	B	
8	3144 Claremont Ave, Oakland	B	
9	53 Tunnel Rd, Oakland	B	
10	284 Piedmont Ave, Oakland	A	
11	423A Shattuck Ave, Oakland	A	
...	...	...	
199	927 W MacArthur Blvd, Oakland	B	
200	59 Chabot Rd #2B, Oakland	B	
201			
202			

These households are in Group A (100 households)

These households are in Group B (100 households)

# Basic Skill #1: How to Randomize Households

	A	C	D
	Household	Group	
1			
2	603 Brookside, Oakland	A	
3	391 Alvarado Rd, Oakland	B	
4	5426 23rd St, Oakland	A	
5	462 College Ave, Oakland	A	
6	927 Broadway #2, Oakland	A	
7	1023 Telegraph Ave, Oakland	B	
8	3144 Claremont Ave, Oakland	B	
9	53 Tunnel Rd, Oakland	B	
10	784 Piedmont Ave, Oakland	A	
11	423A Shattuck Ave, Oakland	A	
...	...	...	
199	927 W MacArthur Blvd, Oakland	B	
200	59 Chabot Rd #2B, Oakland	B	
201			
202			

Aim for 250 in each group = 500 total

These households are in Group A (100 households)

These households are in Group B (100 households)

## Basic Skill #2: How to Measure

A	C	D	E	F
Address	Group	Assessment? (Y/N) (Jan 2010-July 2011)	Upgrade? (Y/N) (Jan 2010-July 2011)	
1st St, Oakland	A	N	N	
2nd Rd, Oakland	B	Y	N	
3rd Oakland	A	N	N	
4th Ave, Oakland	A	N	N	
5th #2, Oakland	A	Y	Y	
6th Ave, Oakland	B	Y	N	
7th Ave, Oakland	B	N	N	
8th Oakland	B	Y	Y	
9th Ave, Oakland	A	Y	Y	
10th Ave, Oakland	A	Y	N	
...	...	...	...	
11th Blvd, Oakland	B	N	N	
12th #2B, Oakland	B	Y	N	

Out of 100 households, group A had a total of 60 Assessments, 20 Upgrades

Out of 100 households, group B had a total of 30 Assessments, 10 Upgrades

## Basic Skill #3: How to Evaluate

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- Involves (very simple) statistics
- At end of presentation





# Summary

- Why experimental design?
- **Questions experimental design can answer (with guest speakers)**
- Light number crunching
- Extensions





## Question 1: *What is the Best Marketing?*

- Some messages can be more effective than others, and intuition doesn't always work to tell you which to choose
- If you want to know which message leads to the most upgrades
- Ideally you would have 2 alternate universes, one with message A and one with message B
- Next best thing: use random assignment



# Question 1: What is the Best Marketing?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

	A	C
	Household	Group
1		
2	1603 Brookside, Oakland	A
3	1491 Alvarado Rd, Oakland	B
4	19426 23rd St, Oakland	A
5	1462 College Ave, Oakland	A
6	1927 Broadway #2, Oakland	A
7	11023 Telegraph Ave, Oakland	B
8	13124 Claremont Ave, Oakland	B
9	153 Tunnel Rd, Oakland	B
10	16094 Piedmont Ave, Oakland	A
11	1422A Shattuck Ave, Oakland	A
...		
12	16077 MacArthur Blvd, Oakland	B
13	1450 Chabot Rd #2B, Oakland	B
201		
202		

**Group A**

**Our BEST OFFER Ever**  
Save Energy. Save Money.



**Group B**

**Our BEST OFFER Ever**  
Save Money.



# Question 1: What is the Best Marketing?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B

Household	Group
1003 Brookside, Oakland	A
1491 Alvarado Rd, Oakland	B
19426 23rd St, Oakland	A
1462 College Ave, Oakland	A
1927 Broadway #2, Oakland	A
11023 Telegraph Ave, Oakland	B
13144 Claremont Ave, Oakland	B
153 Tunnel Rd, Oakland	B
101984 Piedmont Ave, Oakland	A
14122A Shattuck Ave, Oakland	A
...	
10027 W MacArthur Blvd, Oakland	B
11159 Chabot Rd #2B, Oakland	B
201	
0000	

**Group A**

**Our BEST OFFER Ever**  
Save Energy. Save Money.

**Group B**

**Our BEST OFFER Ever**  
Save Money.

Household	Group	Assessment? (Y/N) (Jan 2010-July 2011)	Upgrade? (Y/N) (Jan 2010-July 2011)
1003 Brookside, Oakland	A	N	N
1491 Alvarado Rd, Oakland	B	Y	N
19426 23rd St, Oakland	A	N	N
1462 College Ave, Oakland	A	N	N
1927 Broadway #2, Oakland	A	Y	Y
11023 Telegraph Ave, Oakland	B	Y	N
13144 Claremont Ave, Oakland	B	N	N
153 Tunnel Rd, Oakland	B	Y	Y
101984 Piedmont Ave, Oakland	A	Y	Y
14122A Shattuck Ave, Oakland	A	Y	N
...			
10027 W MacArthur Blvd, Oakland	B	N	N
11159 Chabot Rd #2B, Oakland	B	Y	N

**Group A**

Out of 100 people in group A, 15 upgrades = 15%

**Group B**

Out of 100 people in group B, 10 upgrades = 10%





# Question 1: What is the Best Marketing?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B

Household	Group
1003 Brookside, Oakland	A
1491 Alvarado Rd, Oakland	B
1426 23rd St, Oakland	A
1462 College Ave, Oakland	A
1927 Broadway #2, Oakland	A
1023 Telegraph Ave, Oakland	B
1104 Claremont Ave, Oakland	B
1153 Tunnel Rd, Oakland	B
10284 Piedmont Ave, Oakland	A
142A Shattuck Ave, Oakland	A
...	
1027 W MacArthur Blvd, Oakland	B
1159 Chabot Rd #2B, Oakland	B
201	
1003	

**Group A**

**Our BEST OFFER Ever**  
Save Energy. Save Money.

**Group B**

**Our BEST OFFER Ever**  
Save Money.

Household	Group	Assessment? (Y/N) (Jan 2010-July 2011)	Upgrade? (Y/N) (Jan 2010-July 2011)
1003 Brookside, Oakland	A	N	N
1491 Alvarado Rd, Oakland	B	Y	N
1426 23rd St, Oakland	A	N	N
1462 College Ave, Oakland	A	N	N
1927 Broadway #2, Oakland	A	Y	Y
1023 Telegraph Ave, Oakland	B	Y	N
1104 Claremont Ave, Oakland	B	N	N
1153 Tunnel Rd, Oakland	B	Y	Y
10284 Piedmont Ave, Oakland	A	Y	Y
142A Shattuck Ave, Oakland	A	Y	N
...			
1027 W MacArthur Blvd, Oakland	B	N	N
1159 Chabot Rd #2B, Oakland	B	Y	N

**Group A**

Out of 100 people in group A, 15 upgrades = 15%

**Group B**

Out of 100 people in group B, 10 upgrades = 10%

3<sup>rd</sup>

**Evaluate:** compare and conclude

Message A results in 5% more upgrades than message B





## Question 1: *What is the Best Marketing?*

### Why random assignment is essential

- If you don't randomize, and instead target different messages to different sets of people, what happens?
- For example:
  - Message A is targeted to households in higher income neighborhoods
  - Message B targeted to lower income households
- Problem: people in group A are different than the people in group B (the groups are *not* like alternate universes)
- Can't tell whether message A caused more upgrades, or whether households in higher income neighborhoods (group A) are just more likely to get upgrades



# Real World Example #1

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Speaker: Meredith Fowlie, UC Berkeley  
fowlie@berkeley.edu

Using a slightly more complicated method of experimental design, called **randomized encouragement design**, to evaluate the energy savings caused by the Federal Weatherization Assistance Program in Michigan

# An Experimental Evaluation of the Federal Weatherization Assistance Program

Meredith Fowlie, Michael Greenstone,  
Catherine Wolfram



# The Federal Weatherization Assistance Program

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- Over the past 30 years, an estimated 6.2 million households have received weatherization assistance.
- On the campaign trail, Obama set a goal of weatherizing 1 million low-income homes each year for the next decade.
- The American Recovery and Reinvestment Act allocates almost \$5 billion to weatherization assistance (DOE funding for WAP was \$227 million in 2008).



## **Research questions of primary interest:**

- By how much does weatherization assistance reduce consumption/expenditures at participating households?
- How do experimental estimates of efficiency impacts compare to ex ante engineering estimates and non-experimental empirical estimates?

## **Second order research question:**

- What factors/interventions make households more or less likely to participate in WAP?
- Non-energy benefits of weatherization assistance?

# Program evaluation: A review of the very basics

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*Main objective:* estimate of the impact of a proposed program/ intervention on an outcome of interest in a particular population/sub-population.

**Intervention of interest.** Weatherization assistance.

**Outcome of interest.** Household energy (natural gas and electric) consumption and expenditures.

**Population of interest:** Eligible households.

# Underlying identification problem

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- To estimate the causal effect of weatherization assistance on household energy consumption, we need credible, unbiased estimates of what energy consumption patterns *would* have been in the absence of the intervention.

**Challenge: How to construct a credible and precise estimate of outcomes we cannot observe?!**

# Standard RCT design

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- Individuals are randomly drawn from the population of interest.
- This sample is randomly divided across intervention (*i.e.* treatment) group and a control group; two groups are identical in expectation by design.
- Post-intervention, outcomes are compared across groups to obtain estimate of the average treatment effect.
- **PROBLEM** : Mandating participation of some while preventing participation of others is impossible here.

# A randomized encouragement design

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- Rather than randomize over the intervention itself, we randomly manipulate encouragement to participate.

REDs are particularly useful when:

- Randomization of access or mandatory participation is not practical /desirable./feasible.
- Non-compliance with mandatory assignment in RCT design.
- The effects of both participation and outreach are of policy interest.
- Some encouragement can significantly affect probability of treatment.

# Estimating impacts of the intervention

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- Analysis proceeds by comparing outcomes across encouraged/unencouraged and dividing that difference by the effect of the encouragement on participation.
- Randomized encouragement design gives us an unbiased estimate of the average treatment effect among compliers.

# Strengths of research design

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- Generates plausibly exogenous variation in weatherization assistance treatment assignment.
- Demonstrates how randomization can be incorporated into mainstream energy policy implementation with minimal disruption.
- Potential to experiment with the design of the encouragement in order to investigate responses to different persuasion/motivation strategies.



## Real World Example #2

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Randomized door hanger messages with tips and information, written to emphasize:

- Group A: Save money by conserving energy
- Group B: Protect the environment by conserving energy
- Group C: Join your neighbors in conserving energy
- Group D: Do your part to conserve energy for future generations
- Group E: Conserve energy

Nolan, Schultz, Cialdini, Griskevicius, & Goldstein(2008)

## Real World Example #2

Randomized door hanger messages with tips and information, written to emphasize:

- Group A: Save money by conserving energy
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- Group E: Conserve energy

This group had  
the largest energy  
savings...

## Real World Example #2

Randomized door hanger messages with tips and information, written to emphasize:

- Group A: Save money by conserving energy
- Group B: Protect the environment by conserving energy
- Group C: Join your neighbors in conserving energy
- Group D: Do your part to conserve energy for future generations
- Group E: Conserve energy

This group had the largest energy savings...

...but in a survey, households reported that this message was the *least* motivational.

Experiment, even if you already have an intuition!



## Question 2:

### *What is the Best Incentive Structure?*

- Different types of incentive structures can be more motivating
- Equity – keep the amount of money spent per household the same, just change the way it's given (the “structure”)





# Question 2:

## What is the Best Incentive Structure?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B

Household	Group
1603 Brookside, Oakland	A
1491 Alvarado Rd, Oakland	B
19426 23rd St, Oakland	A
1462 College Ave, Oakland	A
1927 Broadway #2, Oakland	A
11023 Telegraph Ave, Oakland	B
13124 Claremont Ave, Oakland	B
153 Tunnel Rd, Oakland	B
101984 Piedmont Ave, Oakland	A
14122A Shattuck Ave, Oakland	A
...	
10027 W MacArthur Blvd, Oakland	B
11159 Chabot Rd #2B, Oakland	B
201	
3073	

**Group A**

Household gets an assessment for **free**, and a rebate towards a retrofit worth **\$3100**

**Group B**

Household gets an assessment for **\$50**, and a rebate towards a retrofit worth **\$3100 + their \$50 back**

Household	Group	Assessment? (Y/N) (Jan 2010-July 2011)	Upgrade? (Y/N) (Jan 2010-July 2011)
1603 Brookside, Oakland	A	N	N
1491 Alvarado Rd, Oakland	B	Y	N
19426 23rd St, Oakland	A	N	N
1462 College Ave, Oakland	A	N	N
1927 Broadway #2, Oakland	A	Y	Y
11023 Telegraph Ave, Oakland	B	Y	N
13124 Claremont Ave, Oakland	B	N	N
153 Tunnel Rd, Oakland	B	Y	Y
101984 Piedmont Ave, Oakland	A	Y	Y
14122A Shattuck Ave, Oakland	A	Y	N
...			
10027 W MacArthur Blvd, Oakland	B	N	N
11159 Chabot Rd #2B, Oakland	B	Y	N

**Group A**

Out of 100 people in group A, 50 assessments, 10 upgrades = 20% conversion

**Group B**

Out of 100 people in group B, 20 assessments, 10 upgrades = 50% conversion

3<sup>rd</sup>

**Evaluate:** compare and conclude

Incentive structure B results in a higher conversion rate





## Question 2:

# *What is the Best Incentive Structure?*

### **Why random assignment is essential**

- If you don't randomize, and instead let people choose which incentive structure they want, what happens?
- Problem: people in group A, who choose incentive A, are different than the people in group B who choose incentive B (the groups are *not* like alternate universes)
- Can't tell if the difference between A and B is due to the different incentives, or to different types of people



## Real World Example #3

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- Randomized experiment with factory workers in China
  - Workers told that a bonus will be paid in 4 weeks
- Two Groups:
  - Group A - Loss Frame: \$100 Bonus, but for every week that production is low, bonus is reduced by \$20.
  - Group B - Gain Frame: \$20 Bonus, but for every week that production is high, bonus is increased by \$20.
- Two different frames, but same total amount of money in each group
- Result: higher productivity with loss frame

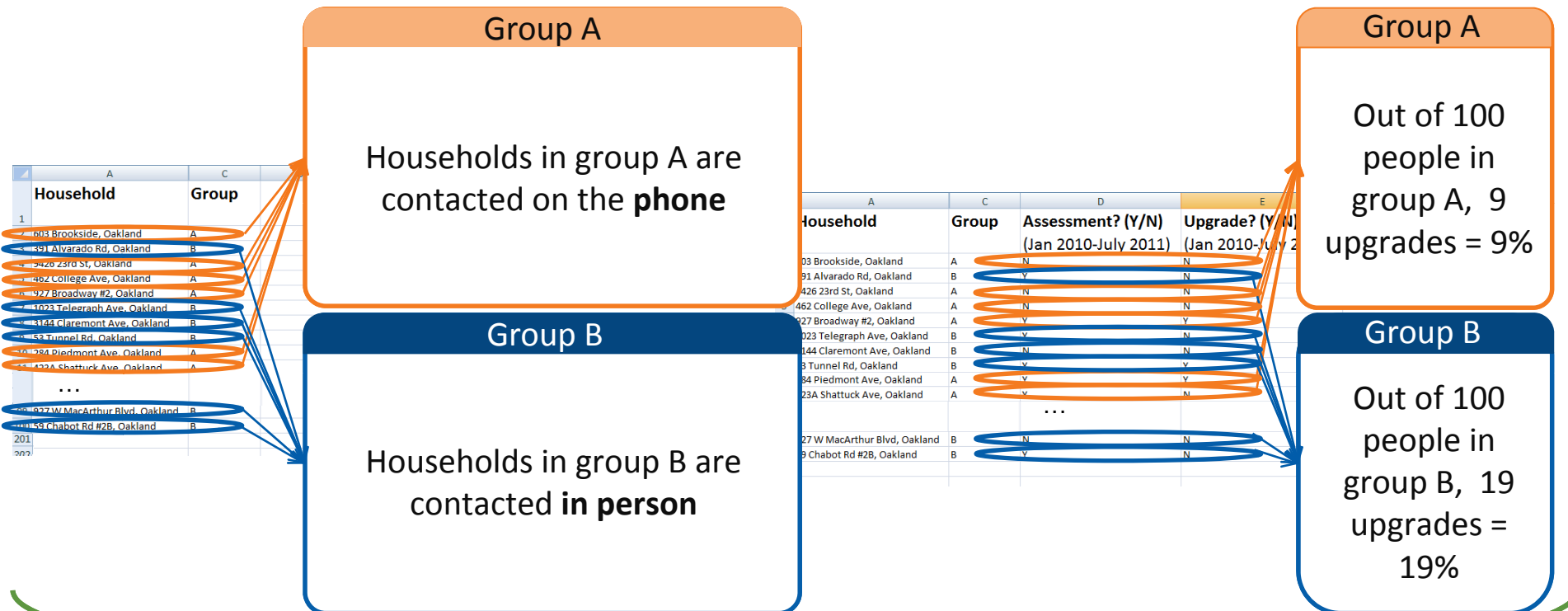
# Question 3: What is the Best Outreach Plan?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B



3<sup>rd</sup>

**Evaluate:** compare and conclude

Outreach method B results in 10% more upgrades







# More Questions

- These are just examples - you can imagine other, similar questions that you could answer with randomized A/B experiments:
- Test other marketing messages in letters, emails, website
  - Framing – *prevent the loss* of money on your bill vs. *save money* on your bill
  - A picture of a happy, comfortable family vs. a picture of nature
- Test other incentives
  - Prescriptive (rebates for specific measures) vs. performance based (target energy savings)
- Packaged structure of recommendations
  - Laundry list of 50 recommendations vs. prioritized and grouped recommendations (comfort package, energy saving package, mixed package)
  - 2 choices (basic package or very expensive package) vs. 3 choices (basic, medium, or very expensive)
- Sales techniques
  - high pressure vs. low pressure



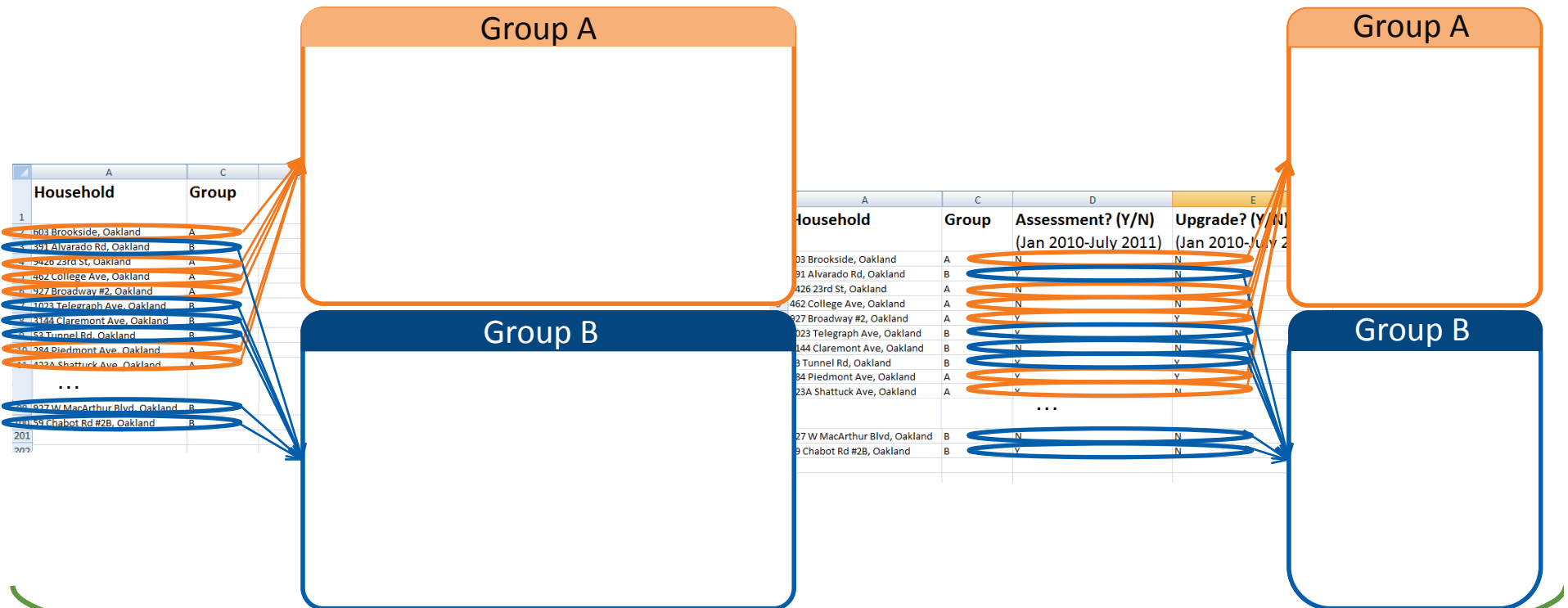
# What would you like to know?

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B



3<sup>rd</sup>

**Evaluate:** compare and conclude



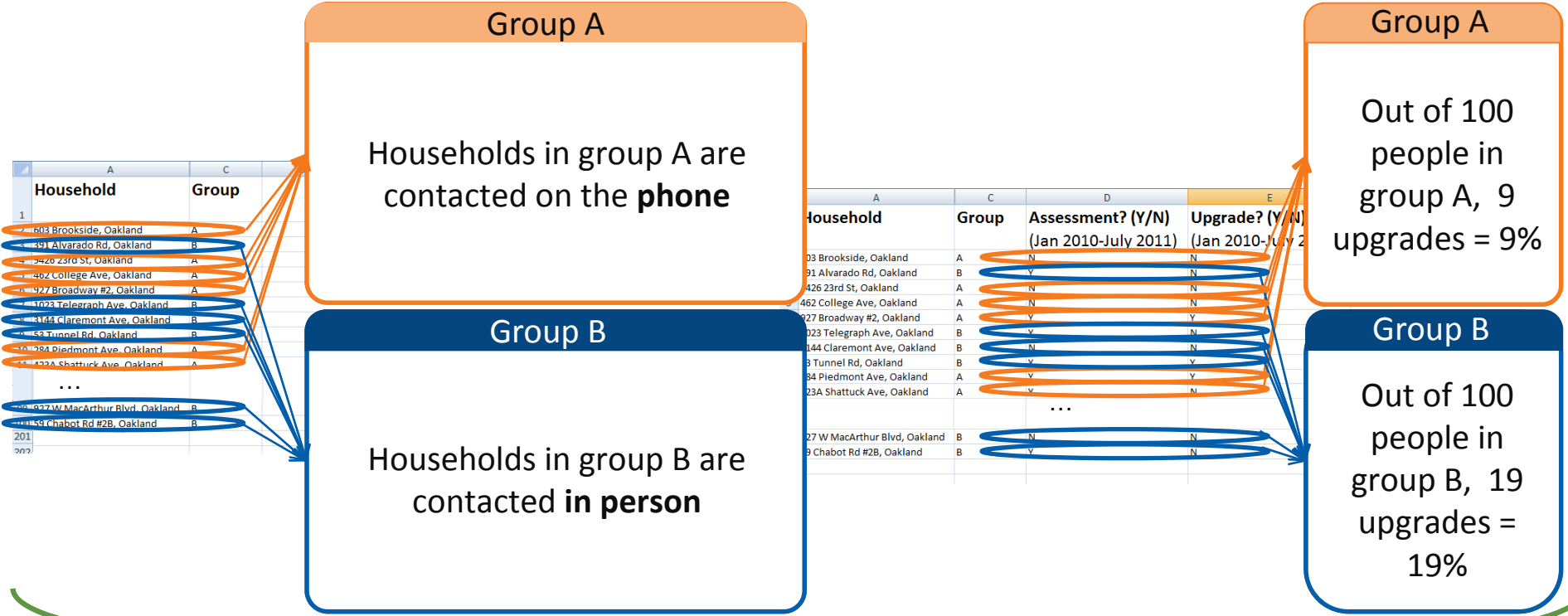
# Next Step: Cost Effectiveness

1<sup>st</sup>

**Randomize:** randomly assign each household to one of two groups

2<sup>nd</sup>

**Measure:** count successes in Group A and Group B



3<sup>rd</sup>

**Evaluate:** compare and conclude

Outreach method B results in 10% more upgrades **AND** relative cost is \_\_\_\_\_





# Summary

- Why experimental design?
- Five questions experimental design can answer (with guest speakers)
- **Light number crunching**
- Extensions





# Light number crunching

- Main point so far:
  1. Randomly assign people into two groups, give each group something different
  2. Count successes in each group
  3. Compare and conclude
- Problem: what if the difference in upgrade percentages between the two groups is just random chance?
- Two issues:
  1. **Small sample size**
    - 500 out of 1000 for group A, 600 out of 1000 for group B
    - 5 out of 10 for group A, 6 out of 10 for group B
  2. **Small differences**
    - 50% for group A, 60% for group B , 1000 people in each
    - 50% for group A, 51% for group B , 1000 people in each





# Light number crunching

- Main point so far:
  1. Randomly assign people into two groups, give each group something different
  2. Count successes in each group
  3. Compare and conclude
- Problem: what if the difference in upgrade percentages between the two groups is just random chance?
- Two issues:
  1. **Small sample size**
    - 500 out of 1000 for group A, 600 out of 1000 for group B
    - 5 out of 10 for group A, 6 out of 10 for group B
  2. **Small differences**
    - 50% for group A, 60% for group B , 1000 people in each
    - 50% for group A, 51% for group B , 1000 people in each

Actually different, or just random chance?



## Basic Skill #3: How to Evaluate (Simple Statistics)

Recall example for outreach plan: group A (phone contact) had 9 out of 100 upgrades (9%), group B, door-to-door, had 19 out of 100 upgrades (19%).

**Step 1:** calculate five numbers:

- $n_A$  = total number of households in group A  $\rightarrow n_A=100$
- $n_B$  = total number of households in group B  $\rightarrow n_B=100$
- $p_A$  = proportion of upgrades in group A ( # of upgrades in A /  $n_A$ )  $\rightarrow p_A = 0.09$
- $p_B$  = proportion of upgrades in group B ( # of upgrades in B /  $n_B$ )  $\rightarrow p_B = 0.19$
- $p_T$  = proportion of total upgrades in group A and B ( # upgrades in A and B / ( $n_A+n_B$ ))  
 $\rightarrow p_T = (9+19)/(100+100) \rightarrow p_T = 28/200 \rightarrow p_T=0.14$

**Step 2:** plug in those five numbers to get the statistic Z:

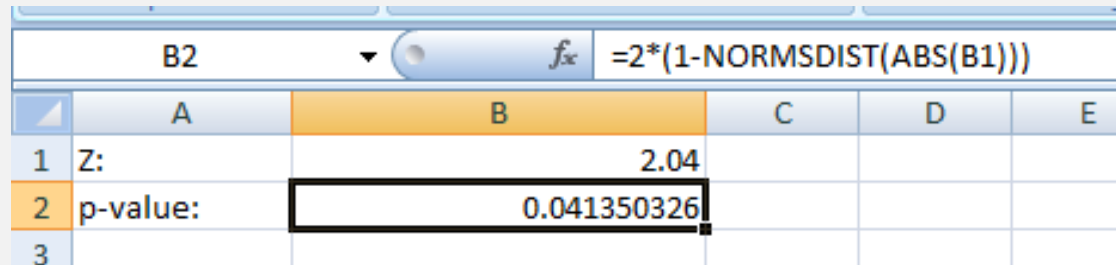
$$Z = \frac{|p_A - p_B|}{\sqrt{[p_T*(1-p_T)*((1/n_A)+(1/n_B))]} } = \frac{|0.09-0.19|}{\sqrt{[0.14*(1-0.14)*((1/100)+(1/100))]} }$$

$$\rightarrow Z = 2.04$$

## Basic Skill #3: How to Evaluate (Simple Statistics)

**Step 3:** look up the **p-value** associated with that Z, and see if the p-value is less than 0.05:

- In Excel: `=2*(1-NORMSDIST(ABS(B1)))`



The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E
1	Z:	2.04			
2	p-value:	0.041350326			
3					

- → p-value < 0.05
- → "The difference is *statistically significant at the 5% level*" (we know that there is only a 5% probability that the difference was caused by chance)
- Conclude that group B had 10% more upgrades, and that it is very unlikely that the 10% difference was caused by random chance → door-to-door outreach **results in 10% more upgrades**



## Basic Skill #3: How to Evaluate (Simple Statistics)

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- If we had found that the p-value was **greater than 0.05**, then we would conclude that although group B had more upgrades, there's too big of a risk that the difference **could have been caused by random chance** → we can not say that one results in more upgrades than the other



# Summary

- Why experimental design?
- Five questions experimental design can answer (with guest speakers)
- Light number crunching
- **Extensions**





# Extensions

1. Randomize Neighborhoods
  - What if you can't randomize households?
  - For example, marketing messages may be in the form of billboards, flyers, and posters, which can't be targeted to specific households
  - Same idea as randomizing households, but slightly more complicated statistics, and need more total people
  - If possible, randomize households
2. Measuring success in terms of customer investment (in dollars)
3. Measure the effectiveness of the program



## Real World Example #5

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Speaker: Kerry O'Neill

Incorporating Experimental Design into Connecticut's Neighbor to Neighbor Energy Challenge, a Better Buildings program



# Neighbor to Neighbor

## ENERGY CHALLENGE

Small Changes. **BIG RESULTS.**

U.S. DOE's EECBG/SEP Technical Assistance Program Webcast -  
Integrating Experimental Design into Your Program

Experimental Design in Action  
August 24, 2011



**Neighbor to Neighbor**  
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## Program Model

### Community-Based marketing/outreach model leveraging state ratepayer fund program for residential customers

- Operating in 14 smaller communities across CT, goal of 1,250 upgrades
  - Range in population from under 5K to about 30K, diverse housing stock, density, demographics, suburban/exurban/rural
- Gateway to upgrade is ratepayer funded direct install/assessment program called Home Energy Solutions (HES)
  - \$75 co-pay to customer, about \$750 value in services, avg. of \$200 annual savings on the first visit (blower door, air/duct sealing, CFLs, water measures, rebates for insulation/appliance upgrade if eligible)
- HES program trying to transition to a focus on deeper retrofits, contractor base not fully there yet
  - This is the goal of N2N – to shift the model from dead-ending at HES towards a market for deeper retrofits, outside the constraints of regulatory cost-benefit tests



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# Campaign Management Tools

## Support Community-Based Acquisition Marketing

- Program Facing
  - Consistent organizing tools in all 14 towns, outreach staff
  - Integrated application/data platform based on Salesforce.com
  - Management reports used to track progress
- Customer Facing
  - Branded town visibility kits
  - Workshops: Home Energy Basics & Deeper Energy Savings
  - Customer follow-up process, Refer-a-friend
  - Online / Social Media: [www.CTEnergyChallenge.com](http://www.CTEnergyChallenge.com) , videos, testimonials, Facebook pages, monthly newsletter & action alerts



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# Hybrid Approach to Analysis

## Qualitative *and* Quantitative Approach:

- Qualitative
  - Listening to the voice of the consumer, Event debriefs
  - Surveys and feedback (online, phone, in person)
- Quantitative Analysis
  - Baseline data on energy usage and ratepayer fund program participation
  - Deep dive on data to evaluate effectiveness of particular strategies
- “A/B” Testing to Refine Messages
  - Email Subject Lines, web/collateral wording
- Social network analysis to:
  - Determine influencers, influenced, and spread of norms and program





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# Experimental Design in Action

**Problem: People get stuck between HES and Upgrades**

## **Research Areas:**

- Comparing Rational & Social Messages, and Saving & Wasting Framing
  - DIY Energy Advisor
  - Refer a Friend Cards
  - Email Subject A/B Testing
  - Newsletter and Energy Action Alert A/B Testing



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**ENERGY CHALLENGE**  
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# Experimental Design in Action

## The DIY Energy Advisor: Behavioral Experiments

- Comparing Rational and Social Messages, and
- Saving vs. Wasting Framing

		Gain/Loss Framing	
		“Rational” Savings	Loss Aversion
Social Scale	Individual Psychology	<u>Control Group (Version 1)</u> *You *Emphasizes Savings	<u>Loss Aversion (Version 2)</u> *You *Emphasizes Waste
	Social Psychology	<u>Social Norms (Version 3)</u> *Us *Emphasizes Savings	<u>Social Norms (Version 4)</u> *Us *Emphasizes Waste



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# The DIY Energy Advisor

## Behavioral Economics Experiments

- Comparing Rational & Social Messages, and
- Saving vs. Wasting Message Framing

**Neighbor to Neighbor ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

Home Take Action Towns Blog & News Events Contact

Slide to improve your home

Current Good Better Best

**Better Retrofit Package**

**Home Ratings & Utilities Costs (Estimate)**

IDEAL Utilities: \$45 **10**  
YOUR NEIGHBORS Utilities: \$88 **9**  
YOU after upgrades Utilities: \$99 **6**

**Impact of this Package**  
Compared to the other suggested packages:  
**Energy Efficiency** ★★★★★  
**Comfort Boost** ★★★★★  
**Health & Safety Improvement** ★★★★★

**Monthly savings\***  
\$37/mo.

**Cashflow\***  
**Right now** Current energy bills \$146/mo  
**After improvement** Reduced energy bills + financed retrofit \$102 + \$7 = \$109/mo

**Start saving today with Home Energy Solutions.**  
For just \$75, get a certified energy professional in your home to help you prioritize and perform these upgrades.  
[Learn more](#)

**Need Help?**  
Call us at **1 (860) 372-4405**

RECOMMENDATIONS FOR YOUR HOME	ANNUAL SAVINGS	RDI	COMFORT	HEALTH & SAFETY
Add Attic Insulation ?	144	✓	✓	
Seal Duct Work or Insulate Heating Pipes ?	98	✓		
Reduce Water Heater Temperature ?	25	✓		✓
Seal Air Leaks ?	156	✓	✓	✓
Replace Doors or Add Storm Doors ?	19		✓	
Reduce Personal Energy Usage ?	224	✓		
Take Shorter Showers ?	49	✓		
Replace Lighting with CFLs ?	128	✓		
Upgrade Water Heater ?	163			✓

\* All numbers are estimated. Actual cost, savings and financing terms may vary.

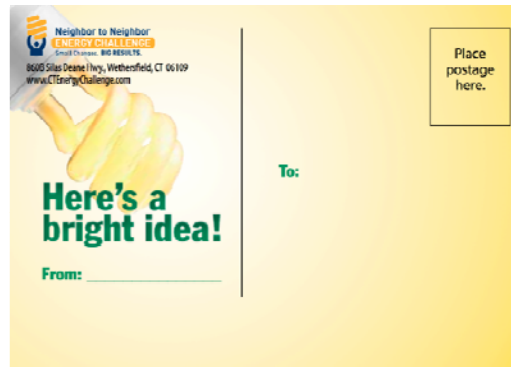


**Neighbor to Neighbor**  
**ENERGY CHALLENGE**  
 Small Changes. **BIG RESULTS.**

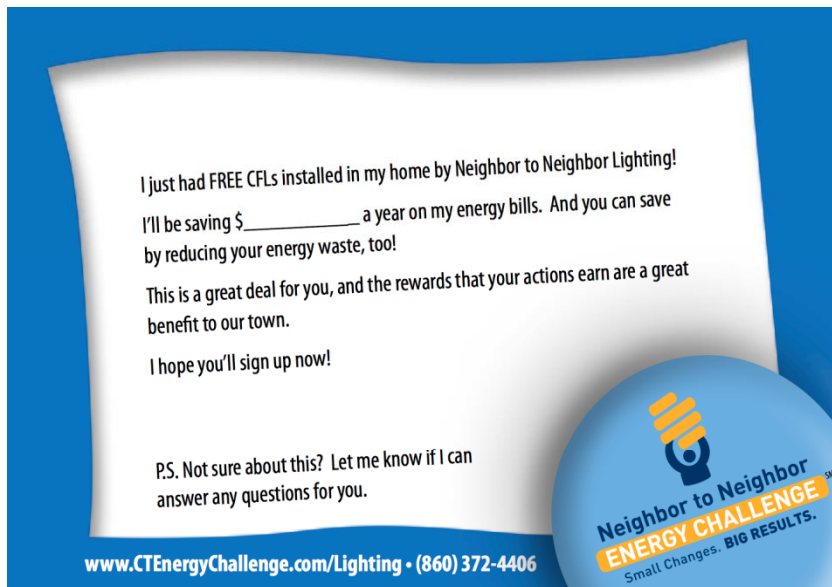
# The Lighting Refer-a-Friend Cards

## Behavioral Economics Experiments

- Comparing Form Letter vs. Slightly Personalized Letter increased social messaging)



Have tested 2 locations in the Lighting Process Flow. Early findings are at the beginning of the visit gets more postcards filled out than the middle of the visit. Still waiting on data from the A/B versions.





**Neighbor to Neighbor**

**ENERGY CHALLENGE**

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## **N2N Action Research**

**A Holistic Approach and Example  
from Jan to Present**



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**ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

# Approach in Action

## Problem: Assessment close rate too low at launch, only 26%!

- How problem was identified:
  - Heads up through informal contractor feedback (Jan/Feb), confirmed in pipeline reports (launched Jan) and dashboards (launched Feb)
- Tools used to analyze problem
  - Listening to the Voice of the Participant exercises with outreach team (Dec and Apr) and contractors (Mar)
  - Deep dive on data to analyze leads from various outreach activities (Mar)
    - How was customer was acquired (workshop, online, tabling event)
    - How long before lead sent to contractor, contractor followed up, etc.
  - Comprehensive process review from initial customer touch to completion of assessment (Mar)



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## Approach in Action

### What we found – Qualitative Analysis:

- People might not want to say “no” to our young, enthusiastic Corps
- Some people wanted more info, but we put them in the scheduling queue and they were non-responsive
- People didn’t understand what they were signing up for
- We didn’t fully understand what we were pitching and how to pitch it
- We weren’t setting appropriate expectations as to the next steps in the process

**Result: we weren’t sourcing enough qualified leads!  
And even some that were qualified were surprised by  
the next steps, so were scared off.**



**Neighbor to Neighbor**  
**ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

## Approach in Action

### What we found – Quantitative Analysis:

- Initial homeowner workshops weren't pulling through any better than tabling at community events – hmmm...
- Contractor getting the most leads (majority of leads in 7 communities) wasn't reporting complete data (over 50% of customer records looked up were missing) – aha!
- Utility program administrator lost leads in Jan and took 14-20 days to distribute leads in periods in Feb and early Mar – whoops!

**Result: even if we were sourcing qualified leads, there was a high degree of probability they were falling through the cracks or going cold. Arrgghh!**





**Neighbor to Neighbor**  
**ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

# Approach in Action

## Solution:

- Take over distribution of leads to contractors – turnaround in 1-2 days
- Get contractors on a Salesforce portal for reporting
- Get the outreach team more education on what happens during the visit
- Refine the “pitch”/collateral used in outreach - developed with outreach team
- Create a “receipt” for customers who sign up, outlining next steps
- Change confirmation email to include contractors name, reminder of where customer signed up
- Conduct survey to learn more about what’s going on
- Next up: N2N to contact non-responsive leads after 2 weeks

**Result: 35% increase in Assessment close rate in April (changes began implementing in mid-Apr). Close rate now at 50% - so still work to do.**



**Neighbor to Neighbor**  
**ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

# Home Energy Solutions Survey

**Problem: People get stuck between HES and Upgrades**

**Approach: Phone/email survey of HES customers, Apr 2011**

**Findings:**

- Improving the Contractor's relationship with the Customer should increase home energy upgrades
  - Homeowners that felt they didn't learn about upgrades were much less likely to plan future upgrades

**Recommendations for Contractors:**

- Spend more time explaining the custom recommendations
- Use tools that describe the return on investment (positive cash flow in many cases) to customers
- Develop processes for post-HES customer follow up (*Note: N2N is in middle of updating the post-HES customer follow up processes*)



**Neighbor to Neighbor**  
**ENERGY CHALLENGE**  
Small Changes. **BIG RESULTS.**

# Additional N2N Research

**Problem: People get stuck between HES and Upgrades**

## **Quantitative Survey of HES customers**

- Track motivations and barriers
- Identify likelihood of moving forward
- Understand value of Energy Advisor
- Use survey to identify customers who need help

## **Qualitative Research**

- Focus groups/one on ones for more in depth insights
- Understand barriers/reactions to N2N Assessment (market-based service for oil-heated homes)



**Neighbor to Neighbor**

**ENERGY CHALLENGE**

Small Changes. **BIG RESULTS.**

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<http://drivingdemand.lbl.gov/>

