

# A/B Testing

**Crowdsourcing and Human Computation**

**Lecture 19**

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**Website: [crowdsourcing-class.org](http://crowdsourcing-class.org)**

# Active versus Passive Crowdsourcing

- So far we have mainly looked at *active* crowdsourcing, where we explicitly solicit help from the crowd
- Many applications of crowdsourcing rely on *passive* information collection from multitudes of individual

# Example: Apple Maps

- iOS 7 allows users to “help improve maps” by enabling a feature called “frequent locations”
- Frequent locations gives Apple a method to verify business locations and other destinations by tracking user movements in the aggregate
- Participation also transmits drive and other travel time data to Apple

# A/B Testing

- A/B Split Testing is a mechanism for passive crowdsourcing that allows web developers to empirically optimize the design of their sites
- Splits web users into two groups and shows them slightly different versions of the site
- Measures the behavior of the groups in aggregate and calculates whether one design leads to a better measurable outcome

# A/B Testing

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# Why A/B tests?

- Lets us evaluate the goodness of alternate designs, instead of relying on our intuitions
- A typical web site may convert only 2% of its visitors into customers
- Small changes can have a big impact
- Google uses A/B testing all the time, and makes it available through Google Analytics

# What sorts of things can you optimize with A/B tests?

- Whether changing the order of collecting form information gets users to stick through to the end
- Whether changing the copywriting on your page improves things
- Whether different images are better at motivating web site visitors to do something that you want them to

What outcomes could  
you measure?



# A/B testing was used to optimize the Obama Campaign

- Kyle Rush was the deputy director of frontend web development at Obama for America
- Managed online fundraising totaling \$690 million in 20 months
- Conducted 500+ A/B tests, which increased the donation conversion rate by 49% and the email acquisition conversion rate by 161%



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No purchase, payment, or contribution necessary to enter or win. Contributing will not improve chances of winning. Void where prohibited. Entries must be received by September 26, 2012. You may enter by contributing to Obama Victory Fund 2012 here or click here to enter without contributing. Three winners will each receive the following prize package: round-trip tickets for winner from within the 48 U.S. States, DC, or Puerto Rico to a destination to be determined by the Sponsor; hotel accommodations; and dinner with President Obama on a date to be determined by the Sponsor (approximate retail value of all prizes \$4,800). Odds of winning depend on number of entries received. Promotion open only to U.S. citizens, or lawful permanent U.S. residents who are legal residents of 48 United States, District of Columbia and Puerto Rico, and 18 or older (or age of majority under applicable law). Promotion subject to Official Rules. Official rules and additional restrictions on eligibility. Sponsor: Obama for America, 1300 S. Randolph St., Chicago, IL 60607.

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## IMAGE VARIATION

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↑ +19%

<http://ky.lerush.net>

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↑ +21%

# Statistics behind A/B testing

- One commonly used method is the G-test
- Invented by Karl Pearson in 1900
- Provides a method for comparing 2 data sets, or answering a yes/no question
- Good tutorial by Ben Tilly on “Effective A/B Testing”

# What to measure?

- Start your A/B test
- Divide your users into groups A and B
- Decide whether each person did what you wanted
- Reduce your results into 4 numbers:  
\$a\_yes, \$a\_no, \$b\_yes, \$b\_no

# Counts of outcomes

	<b>Yes</b>	<b>No</b>	
<b>A</b>	<b>\$a_yes</b>	<b>\$a_no</b>	\$a
<b>B</b>	<b>\$b_yes</b>	<b>\$b_no</b>	\$b
	\$yes	\$no	\$total

# Totals

	<b>Yes</b>	<b>No</b>	
<b>A</b>	\$a_yes	\$a_no	<b>\$a</b>
<b>B</b>	\$b_yes	\$b_no	<b>\$b</b>
	<b>\$yes</b>	<b>\$no</b>	<b>\$total</b>



# Expectations

	Yes	No	
A	$\$e\_a\_yes$	$\$e\_a\_no$	$\$a$
B	$\$e\_b\_yes$	$\$e\_b\_no$	$\$b$
	$\$yes$	$\$no$	$\$total$

$$\$e\_a\_yes = \$a * \$yes / \$total$$

$$\$e\_a\_no = \$a * \$no / \$total$$

$$\$e\_b\_yes = \$b * \$yes / \$total$$

$$\$e\_b\_no = \$b * \$no / \$total$$

# G-test

observations

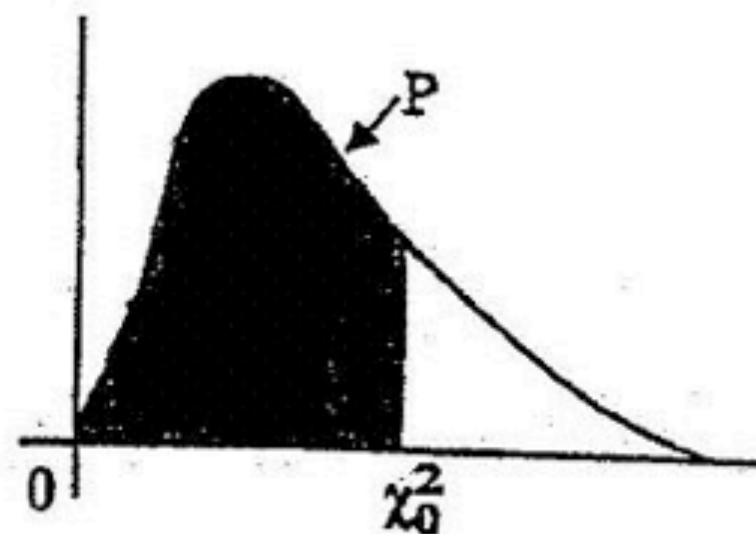
	Yes	No
A	$\$a\_yes$	$\$a\_no$
B	$\$b\_yes$	$\$b\_no$

expectations

Yes	No
$\$e\_a\_yes$	$\$e\_a\_no$
$\$e\_b\_yes$	$\$e\_b\_no$

$$\begin{aligned} \$G\_test = & 2 * ( \$a\_yes * \ln(\$a\_yes / \$e\_a\_yes) \\ & + \$a\_no * \ln(\$a\_no / \$e\_a\_no) \\ & + \$b\_yes * \ln(\$b\_yes / \$e\_b\_yes) \\ & + \$b\_no * \ln(\$b\_no / \$e\_b\_no) \end{aligned}$$

$\chi^2$  Distribution



The table below gives the value  $\chi_0^2$  for which  $P[\chi^2 < \chi_0^2] = P$  for a given number of degrees of freedom and a given value of  $P$ .

Degrees of Freedom	Values of P									
	0.005	0.010	0.025	0.050	0.100	0.900	0.950	0.975	0.990	
1	---	---	0.001	0.004	0.016	2.706	3.841	5.024	6.635	
2	0.01	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	

# G-test Calculator

How many versions?

Success is measured by

- ☒ count of successes  
☐ percentage of trials that succeeded

Use the Yates' continuity correction? ☒

Test	Trials	Success
<input type="text" value="A"/>	<input type="text" value="1000"/>	<input type="text" value="100"/>
<input type="text" value="B"/>	<input type="text" value="500"/>	<input type="text" value="25"/>

The G-test statistic is 11.0928 so version 'A' wins with 99.91% confidence.

<http://elem.com/~btilly/effective-ab-testing/g-test-calculator.html>

# Optimizely

- <http://www.optimizely.com>
- 4 minute video

# A/B Split Testing Protocol

- Identify your initial control web page – this could be your current landing page or whatever you want to optimize
- Establish your goals – what is the thing that you want to optimize? Number of people signing up for your service? Revenue generated by a particular ad campaign?

# A/B Split Testing Protocol

- Determine how long you need to run the experiment – this depends on how much traffic your web site gets, and what level of statistical significance you want
- Create 1 to 3 significant re-designs – your designers can propose a bunch of different overhauls, use the initial phase to hone in on the best high-level re-design

# A/B Split Testing Protocol

- Use A/B testing to choose among the different re-designs. Ideally you can test every pages against every other one, but if that is impractical, you can do a tournament
- Based on the results, choose your true control page – this initial pick will likely generate the lion's share of the improvements



# A/B Split Testing Protocol

- Finally, optimize the nitty-gritty elements of the web page using A/B testing
  - Headline
  - Call to Action
  - Page Copy
  - Graphics
  - Color
  - Configuration of Page Elements
  - Etc.

# Upcoming Guest Lectures

- Wednesday: Ellie Pavlick will give a lecture on prediction markets
- Next Wednesday: Scott Novotney (JHU) will present his research into crowdsourcing for automatic speech recognition systems