



Lecture 8: Randomized Trials

Williams College ECON 204:
Global Poverty and Economic Development
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Randomized Controlled Trials (RCTs) in Development Economics



In 2019, Michael Kremer, Esther Duflo, and Abhijit Banerjee won the Nobel Prize in economics for their promotion of RCTs and their “experimental approach to alleviating global poverty”

RCTs in Development Economics: Busia, Kenya



photo: Stephanie Skinner / Deworm the World

- Michael Kremer convinces NGO ICS Africa to randomize interventions in Kenyan schools
- Study of deworming (w/ Edward Miguel) effectively launches RCT movement

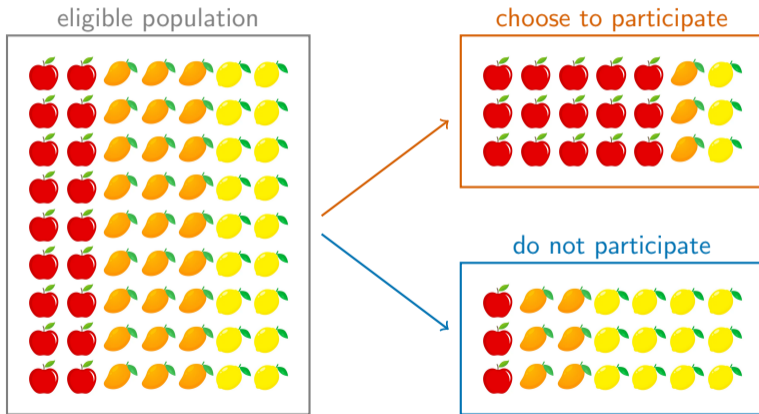
RCTs in Development Economics: Mexico's Progresa



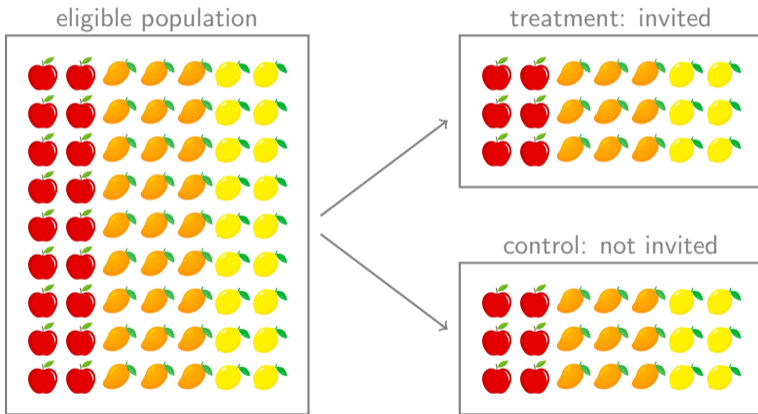
photo: Curt Carnemark / World Bank

- Mexican government piloted conditional cash transfers (CCTs) in the mid-1990s
- Economists within president's office pushed for randomized roll out of pilot
- IFPRI researchers published initial findings in late 1990s

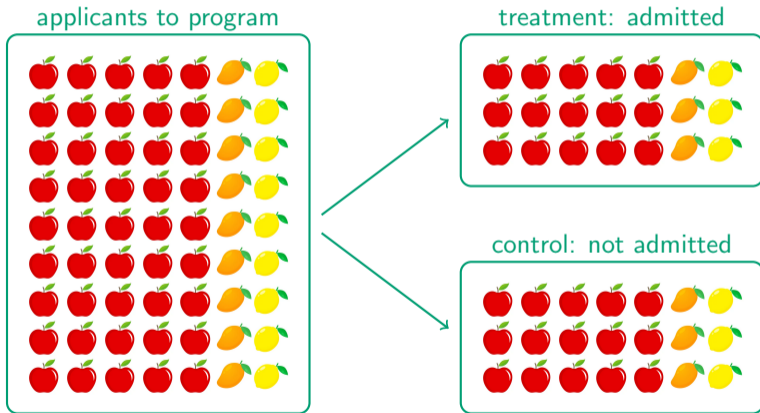
Selection Bias When Program Participation is Endogenous



Random Assignment Eliminates Selection Bias



Random Assignment Eliminates Selection Bias



Treatment and Control Groups Similar in Absence of Program

Treatment, control are representative samples

- Proportion apples (eg.) same as population
- Impact: difference in means ($T - C$)

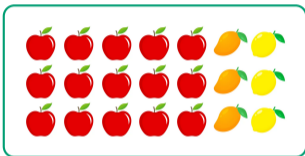
Above is true **on average** (“in expectation”)

- Sometimes treatment group has more apples
- Could difference have occurred by chance?

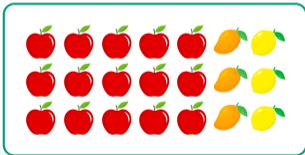
Test hypothesis that T and C have same mean

- Confidence interval: mean $\pm 1.96 \times SE$

treatment: admitted

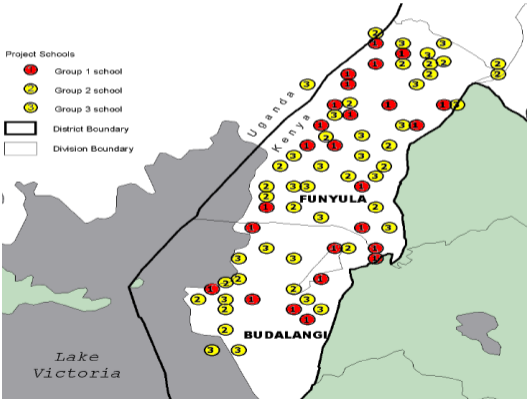


control: not admitted



RCT Example: Deworming

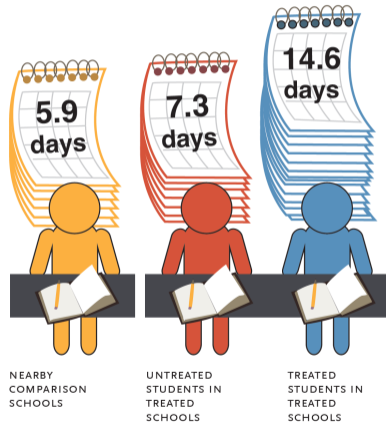
	1998	1999	2000	2001
G1 treatment:		G1 phased in		
G2 treatment:			G2 phased in	
G3 treatment:				G3 phased in
Data collection:	Baseline	Main survey		



Treatment schools received deworming drugs and worm prevention education. Due to high absenteeism, parental non-consent, and other factors, not all pupils in the treatment schools received the deworming drugs. Seventy-eight percent of the pupils assigned to receive treatment were provided at least some deworming treatment through the program in 1998, and seventy-two percent received treatment in 1999.

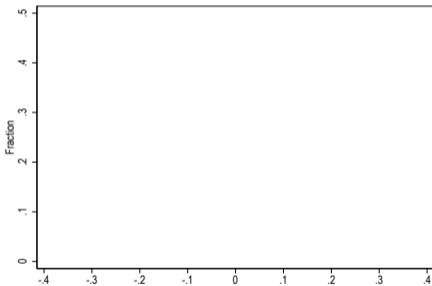


RCT Example: The Impacts of Deworming

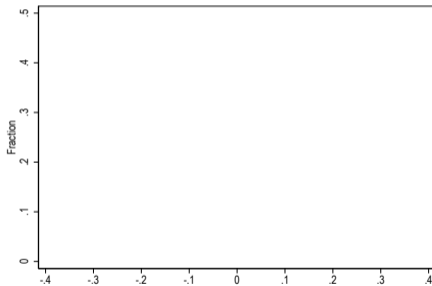


Variance (and Standard Error) of Mean Depend on Sample Size

Thought experiment: population ($N=100$ or $N=1000$) is half apples and half mangoes; randomly assign half to treatment; what is the $T - C$ difference in proportion apples?



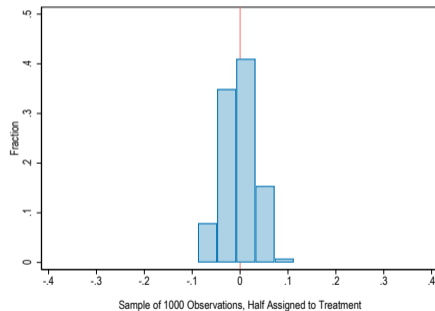
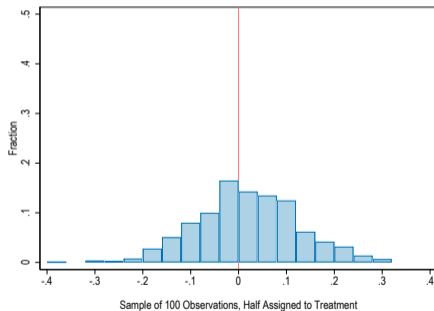
Sample of 100 Observations, Half Assigned to Treatment



Sample of 1000 Observations, Half Assigned to Treatment

Variance (and Standard Error) of Mean Depend on Sample Size

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Randomized Evaluations of Social Policy

When a program is randomly assigned, the difference in average outcomes between the treatment group and the comparison group provides an estimate of the program impact

- We also need to ask whether the difference is **statistically significant**
- We gauge statistical significance by looking at the **p-value**
 - ▶ Given the sample size and the variability of X , what is the probability that a difference in average outcomes as large as the one we actually observe could have occurred by chance?
 - ▶ We say that the effect is statistically significant if $p < 0.05$
- We can also look at the **t-statistic** (point estimate/standard error)
 - ▶ A t-statistic of 1.96 is equivalent to a p-value of 0.05

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We will examine program impacts using a t-test: are means the same in treatment vs. control?

tabulate and summarize

The Stata command `tabulate x` reports the observed values of `x` and their frequencies

```
. tabulate x
```

x	Freq.	Percent	Cum.
0	500	50.00	50.00
1	500	50.00	100.00
Total	1,000	100.00	

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Total	1,000	100.00	

The Stata command `summarize x` reports the means, standard deviation, etc. of `x`

```
. summarize x
```

Variable	Obs	Mean	Std. dev.	Min	Max
x	1,000	.5	.5002502	0	1

Stata Syntax: Abbreviations and if Statements

`tabulate` and `summarize` can be abbreviated

- `sum x` is equivalent to `summarize x`
- `tab x` is equivalent to `tabular x`

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We can add an `if` statement to (almost) any Stata command restrict the analysis sample

- `tab x if treatment==1` would tell us the values of `x` in the treatment group

Stata Syntax: help

You can review the syntax for any command by typing `help command`

Syntax

```
summarize [varList] [if] [in] [weight] [, options]
```

options

Description

Main

<u>detail</u>	display additional statistics
<u>meanonly</u>	suppress the display; calculate only the mean; programmer's option
<u>format</u>	use variable's display format
<u>separator(#)</u>	draw separator line after every # variables; default is <code>separator(5)</code>

sum x, d

`summarize x, detail` also reports the variance of `x` and some of the percentiles

```
. summarize x, d
```

		x			
Percentiles		Smallest			
1%	0	0			
5%	0	0			
10%	0	0	Obs		1,000
25%	0	0	Sum of wgt.		1,000
50%	.5		Mean		.5
		Largest	Std. dev.		.5002502
75%	1	1			
90%	1	1	Variance		.2502503
95%	1	1	Skewness		0
99%	1	1	Kurtosis		1

The Variance of a Dummy Variable

In this example x is a dummy variable equal to either 0 or 1

- \bar{x} is the mean of the dummy variable, i.e. the proportion of observations with $x = 1$

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The **variance** of a dummy variable is $S^2 = \frac{1}{N-1} \sum_N (x - \bar{x})^2 = \bar{x}(1 - \bar{x}) \left(\frac{N}{N-1} \right)$

- The **standard deviation** is the square root of the variance
- The **standard error** is the standard deviation divided by \sqrt{N}
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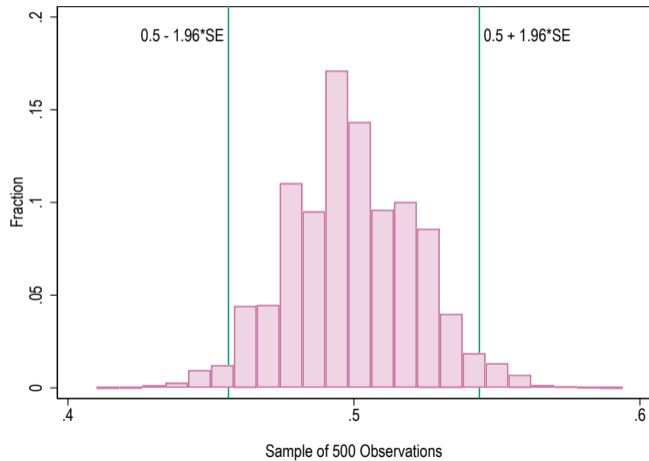
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The **95 percent confidence interval** for the mean of x is:

$$\left[\bar{x} - 1.96 \times \sqrt{\bar{x}(1 - \bar{x})/(N - 1)}, \bar{x} + 1.96 \times \sqrt{\bar{x}(1 - \bar{x})/(N - 1)} \right]$$

Confidence Intervals for Means



ttest

The `ttest` command tests the equality of means (syntax: `ttest y, by(treatment)`)

```
. ttest y, by(treatment)
```

Two-sample t test with equal variances

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf. interval]	
0	100	.4	.0492366	.492366	.3023039	.4976961
1	100	.58	.0496045	.496045	.4815739	.6784261
Combined	200	.49	.035437	.5011544	.4201198	.5598802
diff		-.18	.0698917		-.3178276	-.0421724

```
diff = mean(0) - mean(1)                                t = -2.5754  
H0: diff = 0                                           Degrees of freedom = 198
```

```
Ha: diff < 0                Ha: diff != 0                Ha: diff > 0  
Pr(T < t) = 0.0054          Pr(|T| > |t|) = 0.0107          Pr(T > t) = 0.9946
```

Lab: Subsidizing Malaria Treatment in Kenya

Comparison Group

No subsidy. Households received vouchers to purchase unsubsidized ACTs at the pre-AMFm retail price in Kenya: KSh 500 (approximately US\$6.25, using a 2009 exchange rate of KSh 80/ US\$1).

ACT Subsidy

Households were randomly selected to receive vouchers for ACTs at one of three subsidy levels:

- **92 percent** (US\$0.50 per adult dose, corresponds to the Kenyan government's target retail price of KSh 40 under the AMFm)
- **88 percent** (US\$0.75 per adult dose)
- **80 percent** (US\$1.25 per adult dose)

ACT & RDT Subsidy

Households received one of the three ACT subsidy levels above and were also randomly assigned to receive vouchers for rapid diagnostic tests (RDTs) either for free or at an 85 percent subsidy (US\$0.20).



PHOTO BY AUDE GUERRUCCI

Lab: Subsidizing Malaria Treatment in Kenya

POLICY LESSONS



PHOTO BY IPA KENYA

Understanding the Context

The data collected during this evaluation suggest that households in the study area:

- Tend to bypass the public health care system if they are poor, likely because they live far from health centers, making travel costs too high. Instead they rely on local drug shops that do not offer diagnostic services.
- Experience illnesses suspected to be malaria very often. These illness episodes are generally not formally diagnosed and are typically presumptively treated with less effective antimalarials procured from a drug shop.

Subsidizing ACTs provides measurable benefits, especially for vulnerable children and the poorest households. Many households effectively miss out on the existing free treatment at public facilities and either do not seek care for malaria at all or take less effective medicines. For these families, a retail-sector ACT subsidy substantially improves access to proper treatment.

A slightly lower subsidy can improve targeting without compromising access for children. Moving from the AMFm target subsidy level (roughly 92 percent) to a somewhat lower subsidy (80 percent) reduced overtreatment among adults, while keeping access constant for children. These results suggest that an ACT subsidy is clearly needed, but that a slightly lower subsidy may achieve similar benefits at a lower cost.

Rapid diagnostic tests may be a promising means to improve targeting. People were very willing to try out rapid diagnostic testing, including sharing the cost of the test. More than half of adults who suspected malaria but got a negative test result decided not to purchase the subsidized ACT. Imperfect compliance with malaria test results is also common among public health workers, and thus it may take some time for people with malaria to become familiar with and trust RDTs.