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Data-driven Approaches to Monitoring & Evaluation

30th of July 2021

Kenneth Ryu

Agenda:

- Importance of measures of spread and of counterfactual group
- Introduction of Nobel prize of economics in 2019 for poverty alleviation with data-driven M&E
- Data collection, Type of data, nature of data
- Mean difference test & Randomized Controlled Trial
- Theory of impact evaluation and pros & cons of each different methodologies
- Examples with different methodologies
- Q&A

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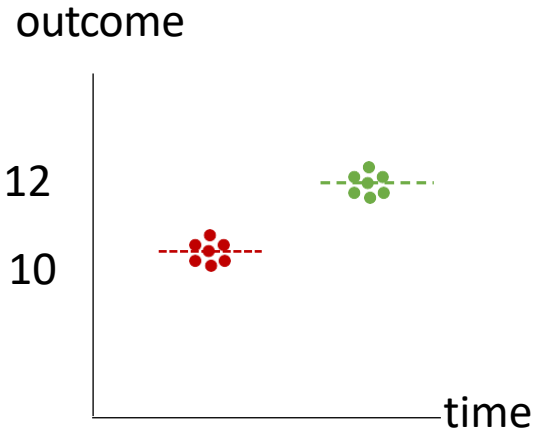
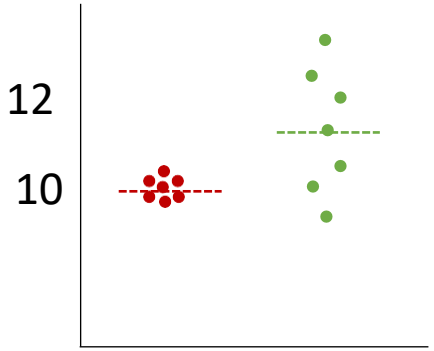
Group Discussion: Which program better performs?

Situation I: A vs. B

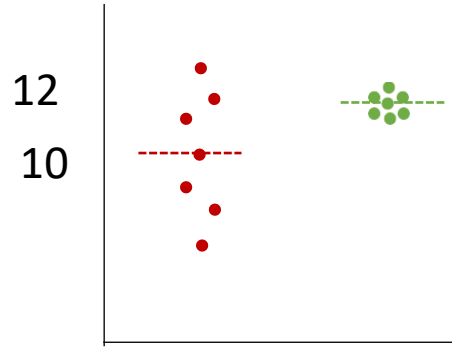


Before vs. After
(low spread to low spread)

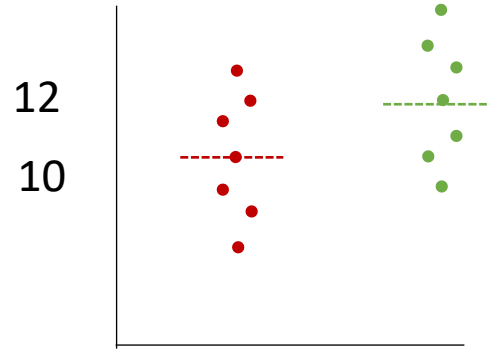


Before vs. After
(low spread to high spread)

Situation II :C vs. D



Before vs. After
(high spread to low spread)



Before vs. After
(high spread to high spread)

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How did they win Nobel Prize of economics in 2019

With topics of

Monitoring & Evaluations?

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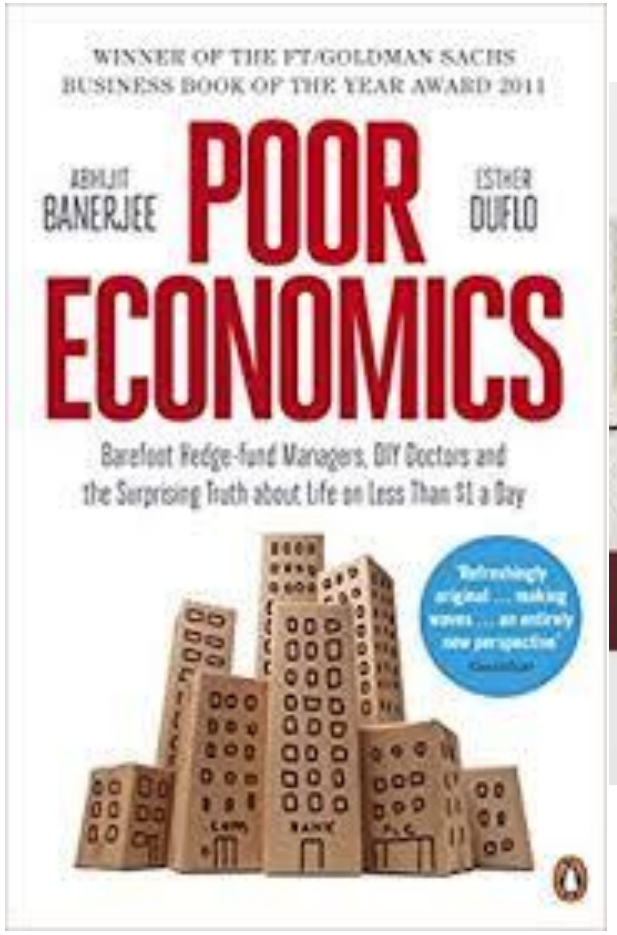
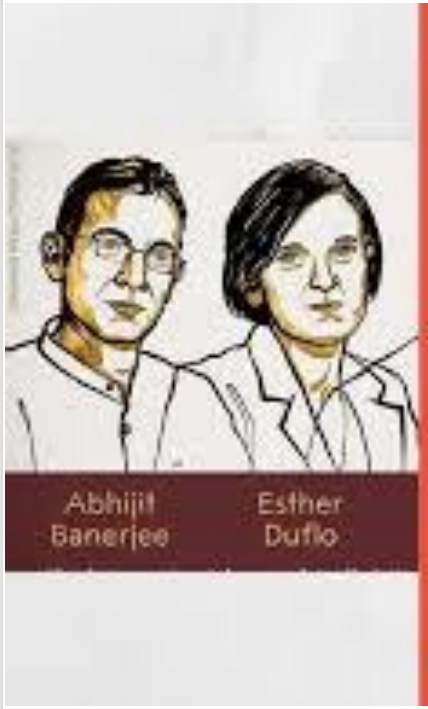
Nobel prize winners of Economics 2019





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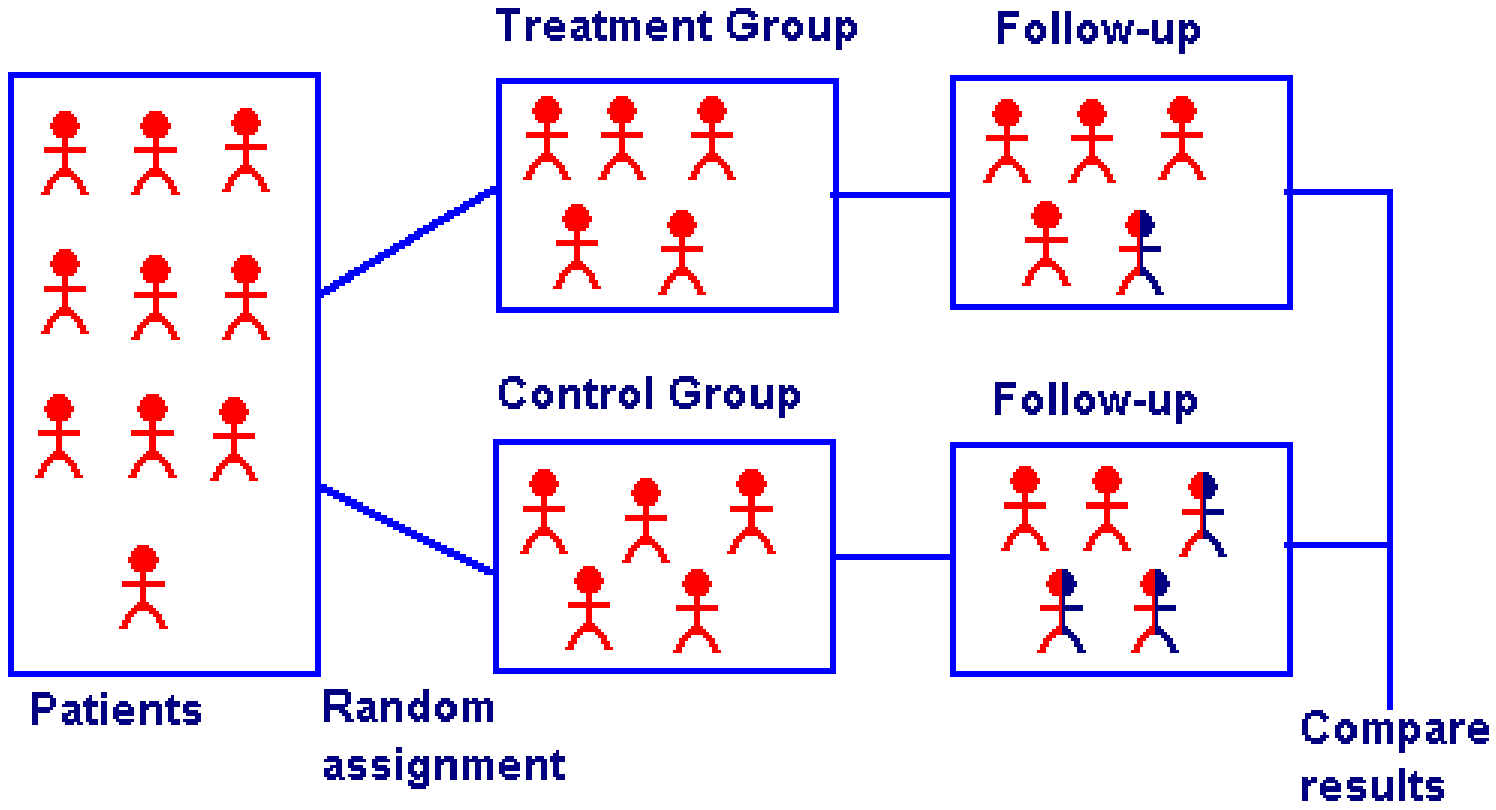
What is Randomized controlled trial:

- The gold standard for testing the effectiveness of new treatments in clinical test and also NGO program
- In order to answer whether or not a particular treatment has a statistically significant effect.



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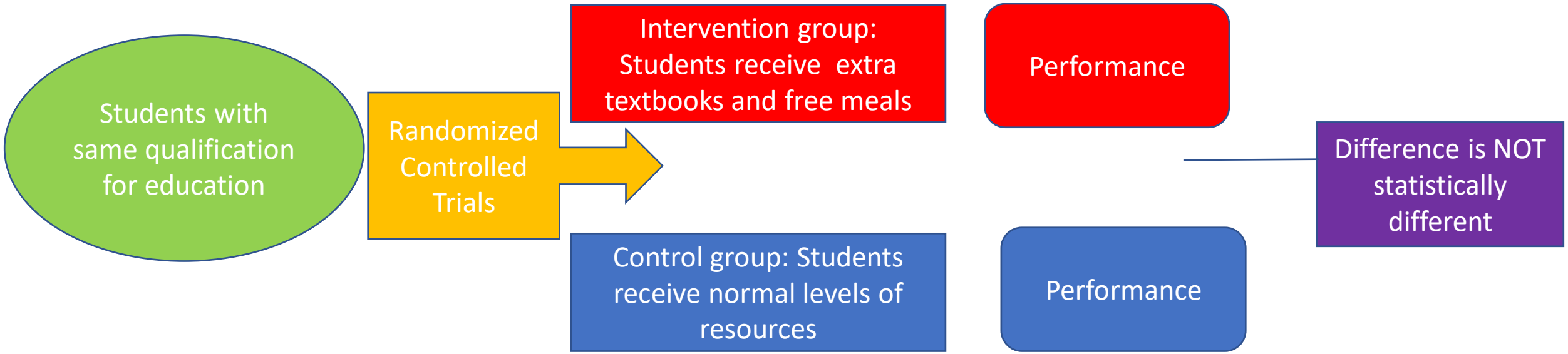
An example of Randomized controlled trial:



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Ways of data collection:

Type of data collection	Description	Sampling variability	Pros/Cons
Census	Collect data from every unit in a population Collecting data about the height of everyone in your class	zero sampling variability of statistic because it is calculated using data from the entire population.	Cons(Cost, Time, Response burden, Issues of Control for all unit)
Sample survey	only part of the total population is approached for data. If you collected data about the height of 10 students in a class of 30	Non-zero sampling variability of statistic because it is calculated using a portion of data from the entire population.	Pros(Cost, Time, Response burden, Issues of Control for all unit)
Administrative data	a result of an organization's day-to-day operations. Examples include data on births, deaths, marriages, divorces and car registrations	zero sampling variability of statistic because it is calculated using data from the entire population.	Cons(Flexibility, Pros(Time series, simplicity, Response burden)

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Type of Data by how they are preceived

Type of data collection	Description	Example	Pros/Cons
Subjective data	Data from an interviewee's point of view, perception, concerns and feelings	Do you feel confident in facing your problems? Choices(0,1,2,3,4,5) from extremely unconfident to extremely confident	Pros: Suitable for specific research related to soft skills Cons: possible bias of response; interview skill matters
Objective data I	measurable, obtained through physical examination	(purely physical)Smog in the air Blood pressure	Pros: straightforward Cons: not flexible for the way of data-collection
Objective data II	Observable and obtained through diagnostic testing	(combined with human judgment or observation) Attendance of students Score of examination	Pros: flexible with human design Cons: not flexible for the way of data-collection

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Nature of Data

Type of Data	Definition	Examples
Quantitative & continuous	could be divided and reduced to finer and finer levels	ex) height, weight and length
Quantitative & discrete	a count that can't be made more precise	“the number of children in your family“, “the number of attacks of asthma per week”
Qualitative & ordinal attribute	categories that do have some kind of implicit or natural order	"Short, Medium, or Tall." “strongly agree, agree, neutral, disagree, strongly disagree”
Qualitative & nominal attribute	categories that do not have an implicit or natural value or rank	red/yellow/blue, negro/ caucasian/ Asian
Qualitative binominal(binary) attribute	one of two mutually exclusive categories	right/wrong, true/false, or accept/reject, male/female
Qualitative data (Open)	Random and open data	What type of lady you want to marry?

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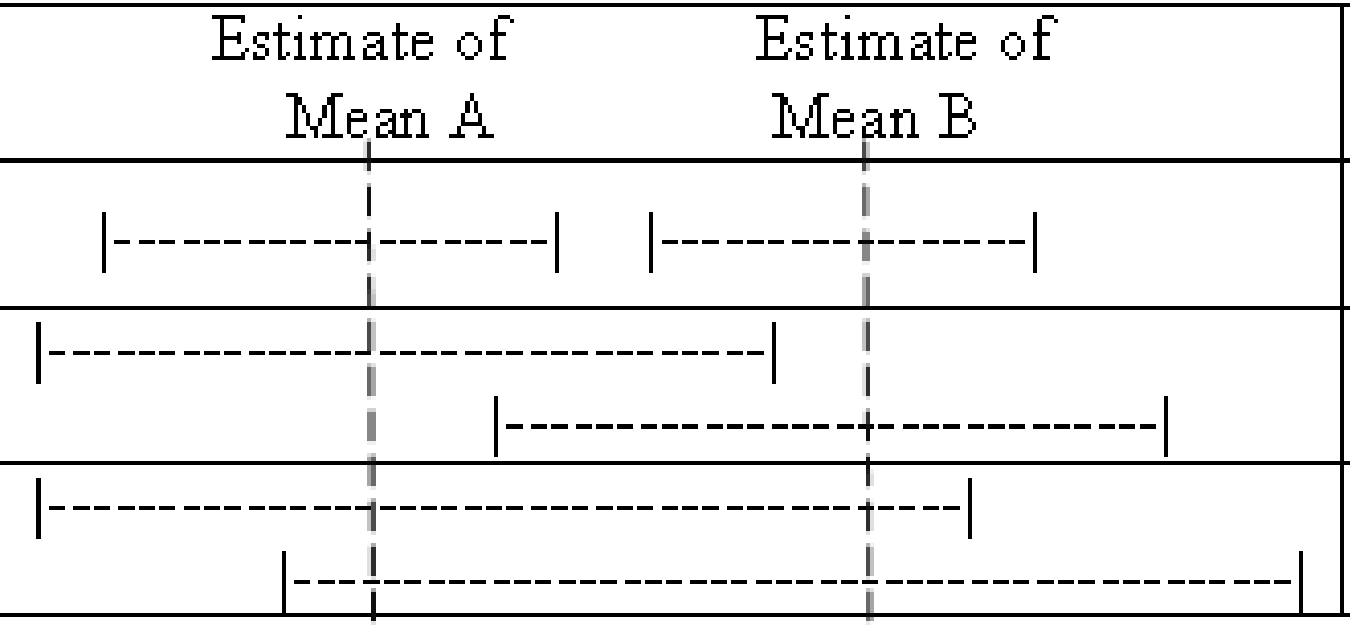
Mean difference test = comparison of confidence interval between groups

	convincing evidence of a difference
	~~strong evidence of a difference~~
	no evidence of a difference

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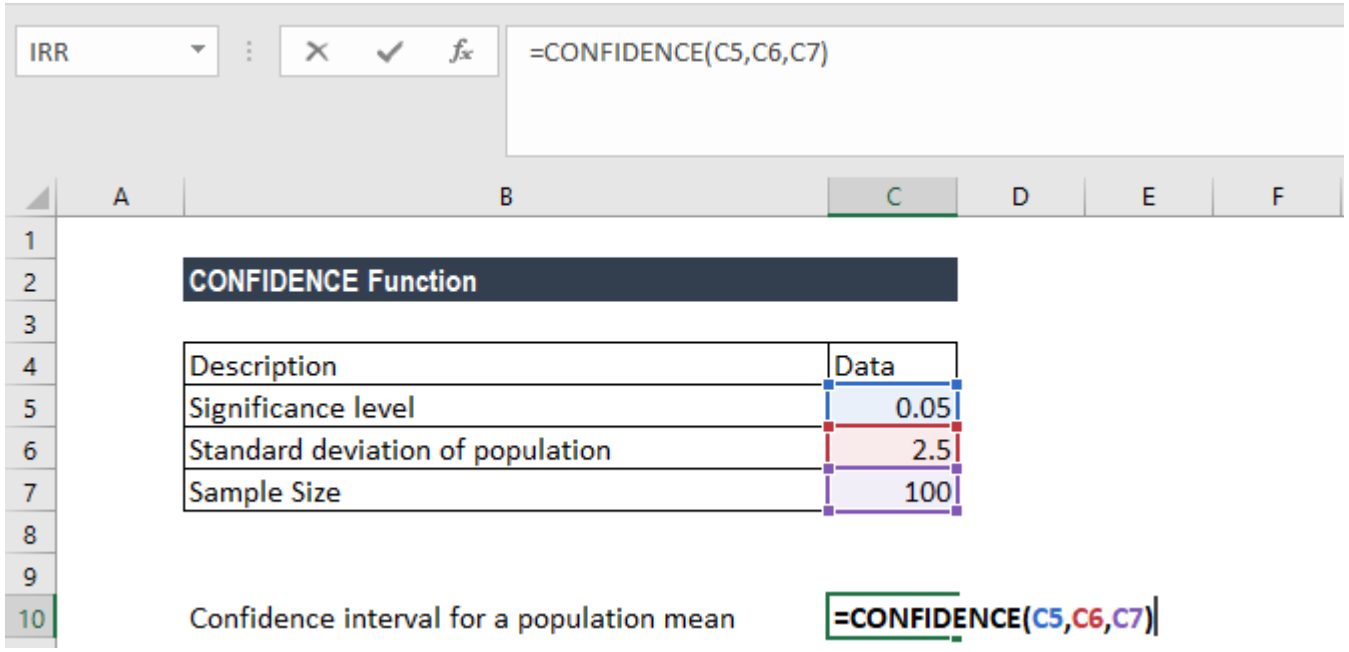
Confidence interval: concept, mathematical formula and excel function

- a range of values so defined that there is a specified probability that the value of a parameter lies within it.

$$\bar{X} \pm 1.96 * \frac{s}{\sqrt{n}}$$



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2 Pieces of statistical skills: WE CAN DO!

- Mean difference test(t-test): We already learned !

- Randomized Controlled Trials: We'll try later!

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Impact Evaluations: Different methodologies

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Impact Evaluation methodologies

- Evaluate impact through comparing outcomes to a **counterfactual**
- Methods for constructing the counterfactual:
  - Pre-post
  - Simple Difference
  - Difference-in-Difference
  - Regression Analysis
  - Randomization
- Case: NGO program in India

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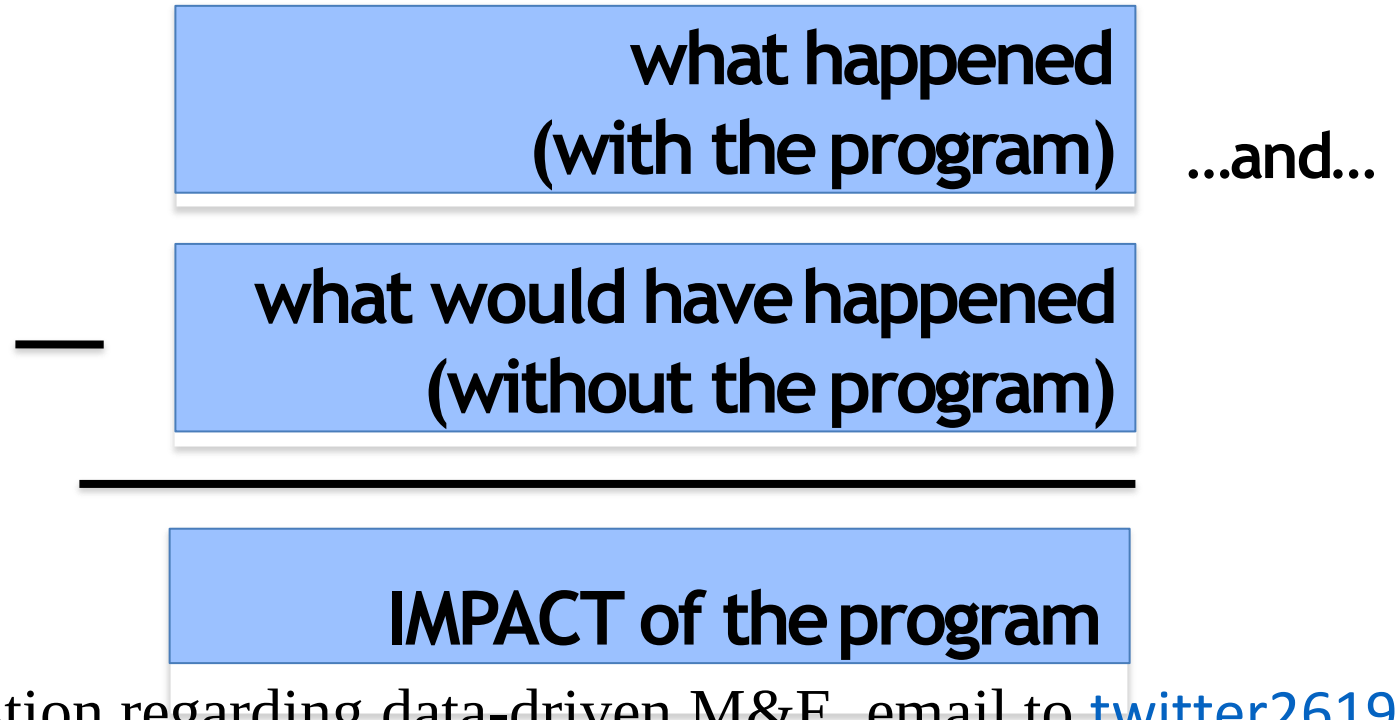
How to measure impact

- IMPACT
  - What happened **because of the program**
  - The difference from what would have happened ***in the absence of the program***



Counterfactual

- The ***counterfactual*** represents the state of the world that program participants would have experienced in the absence of the program (i.e. had they not participated in the program)

- ***Problem***: Counterfactual cannot be observed

- ***Solution***: We need to "mimic" or construct the counterfactual

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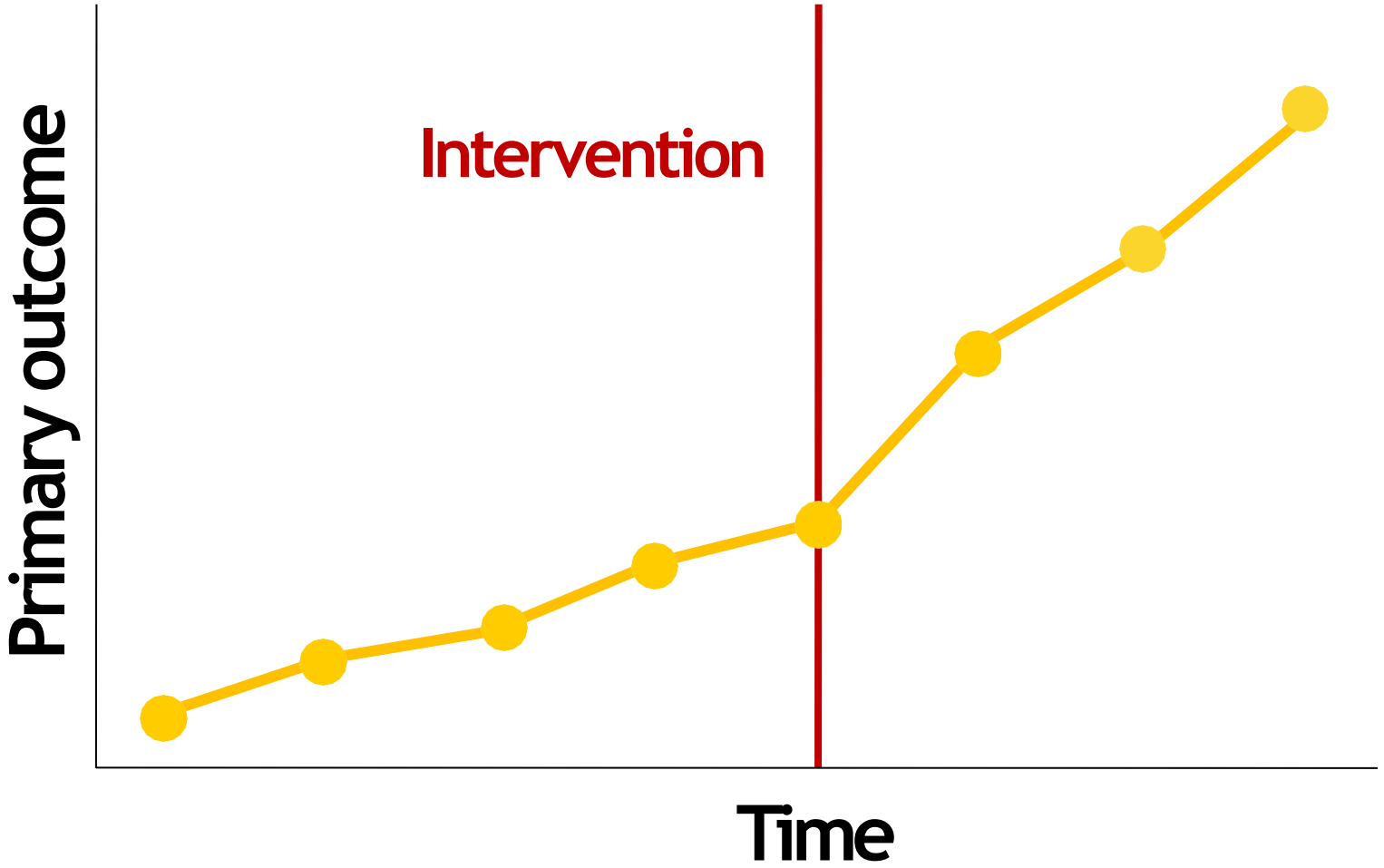
How to measure impact



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Quiz: What is the impact?

a) Positive

b) Negative

c) Not enough information

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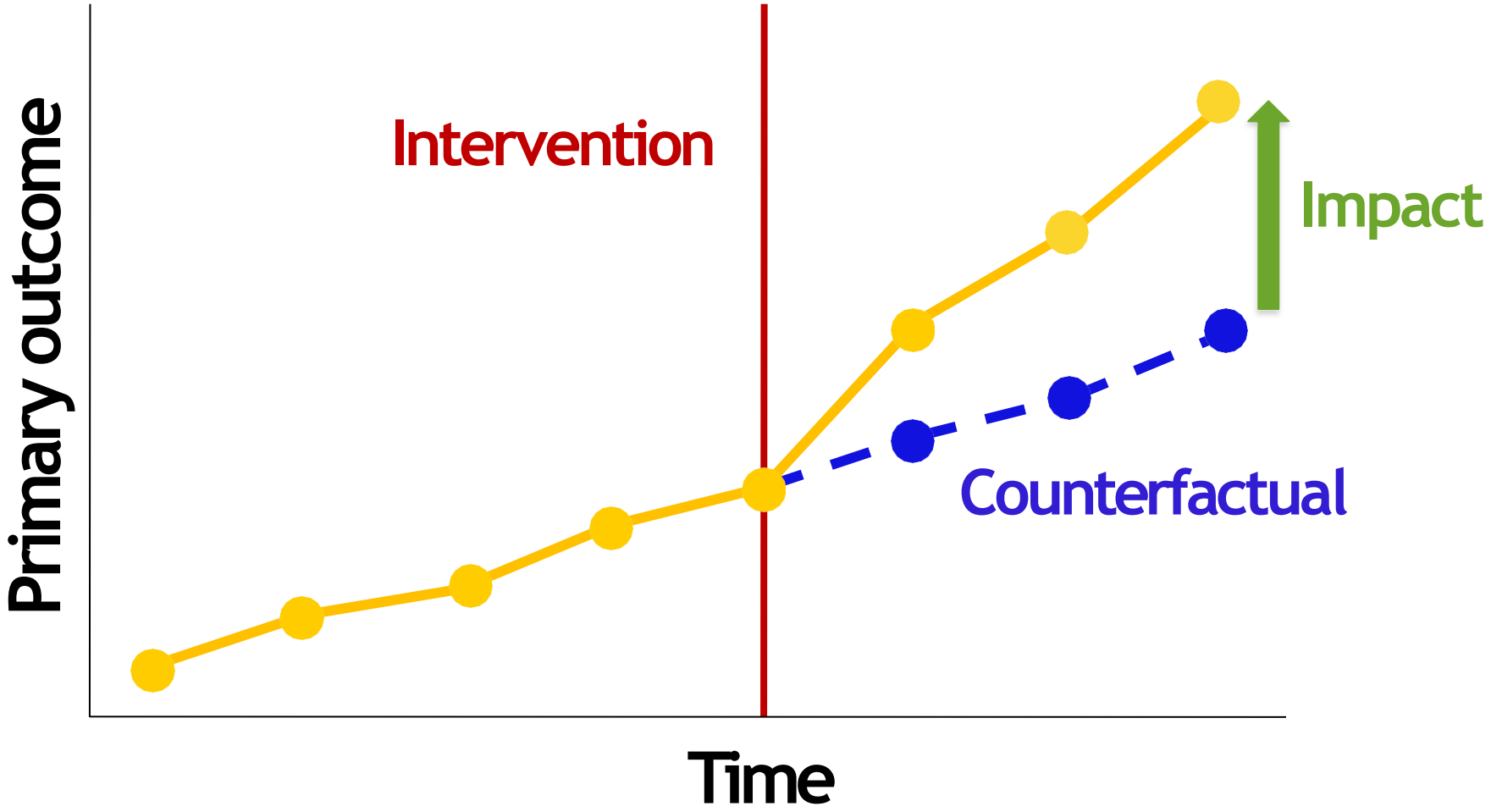
How to measure impact



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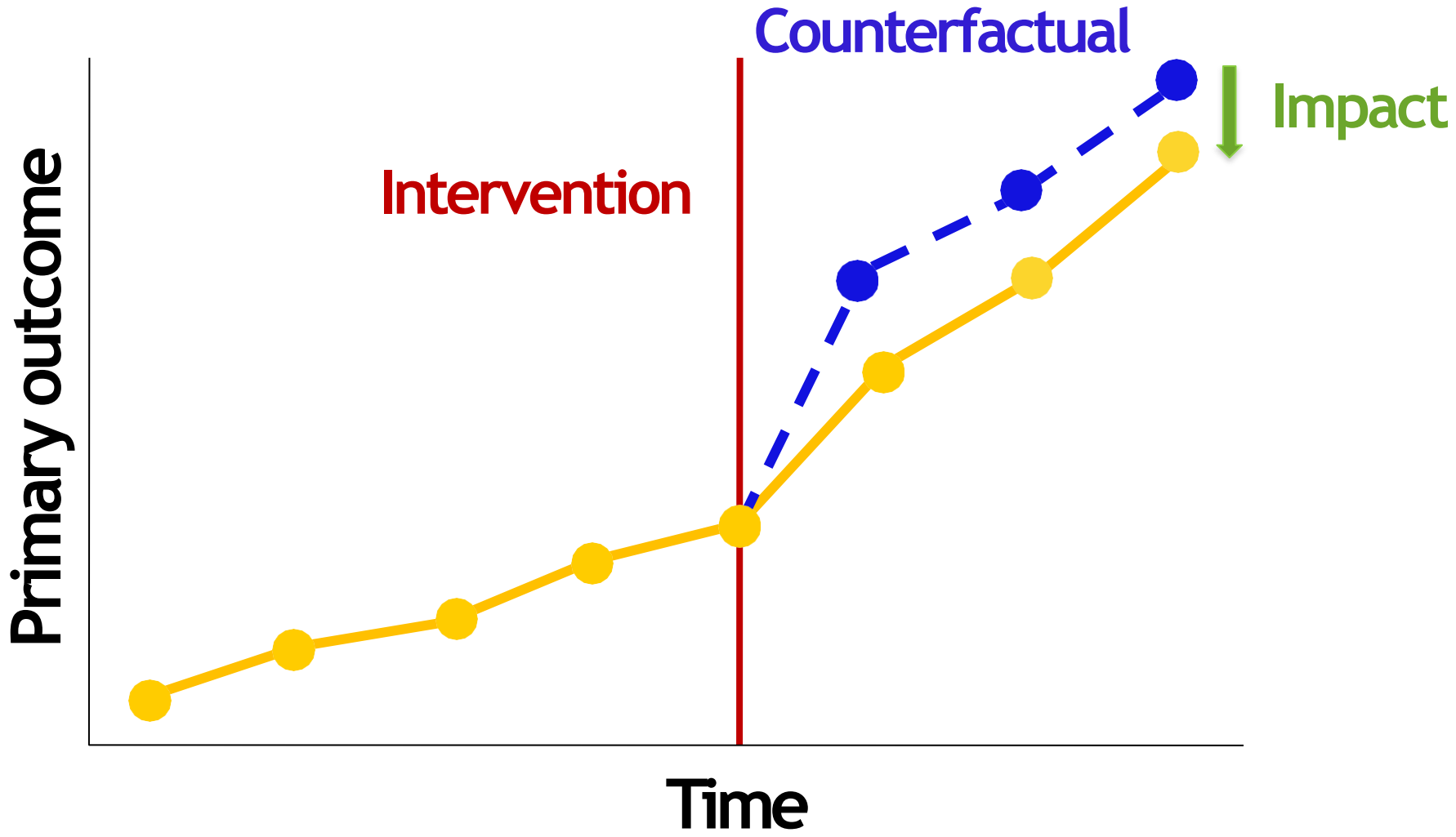
How to measure impact



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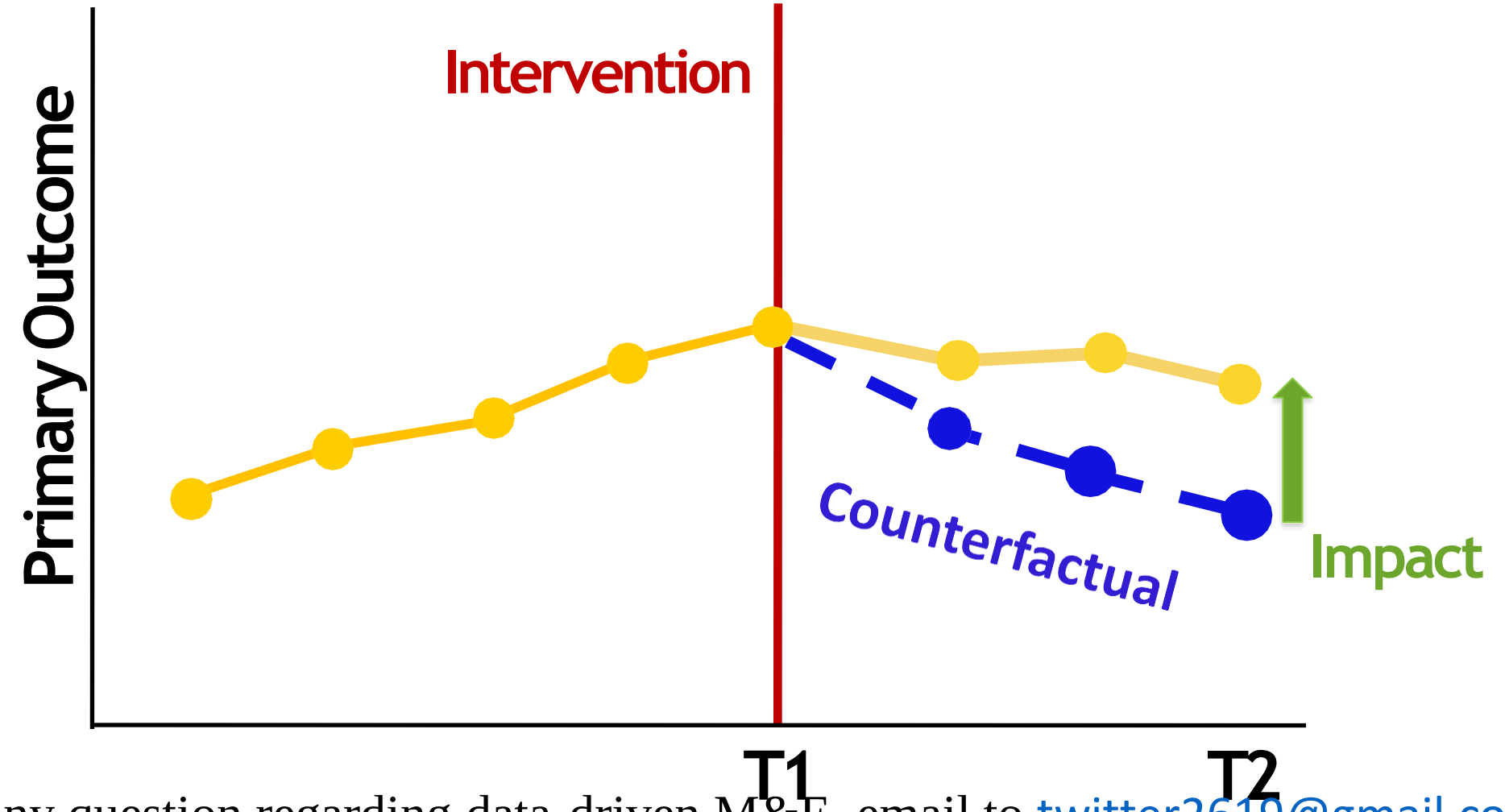

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We can't accurately estimate impact without finding a way to accurately represent the counterfactual

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Lecture Overview

- Evaluate impact through comparing outcomes to a **counterfactual**
- Methods for constructing the counterfactual:
  - Pre-post
  - Simple Difference
  - Difference-in-Difference
  - Regression Analysis
  - Randomization
- Case: NGO program in India

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Constructing the counterfactual

- One of the most common methods for tracking impact is comparing data for the program participants **BEFORE** and **AFTER** the intervention

Pre-post

- In Pre-post, the counterfactual is represented by the **same** group **before** they got the program

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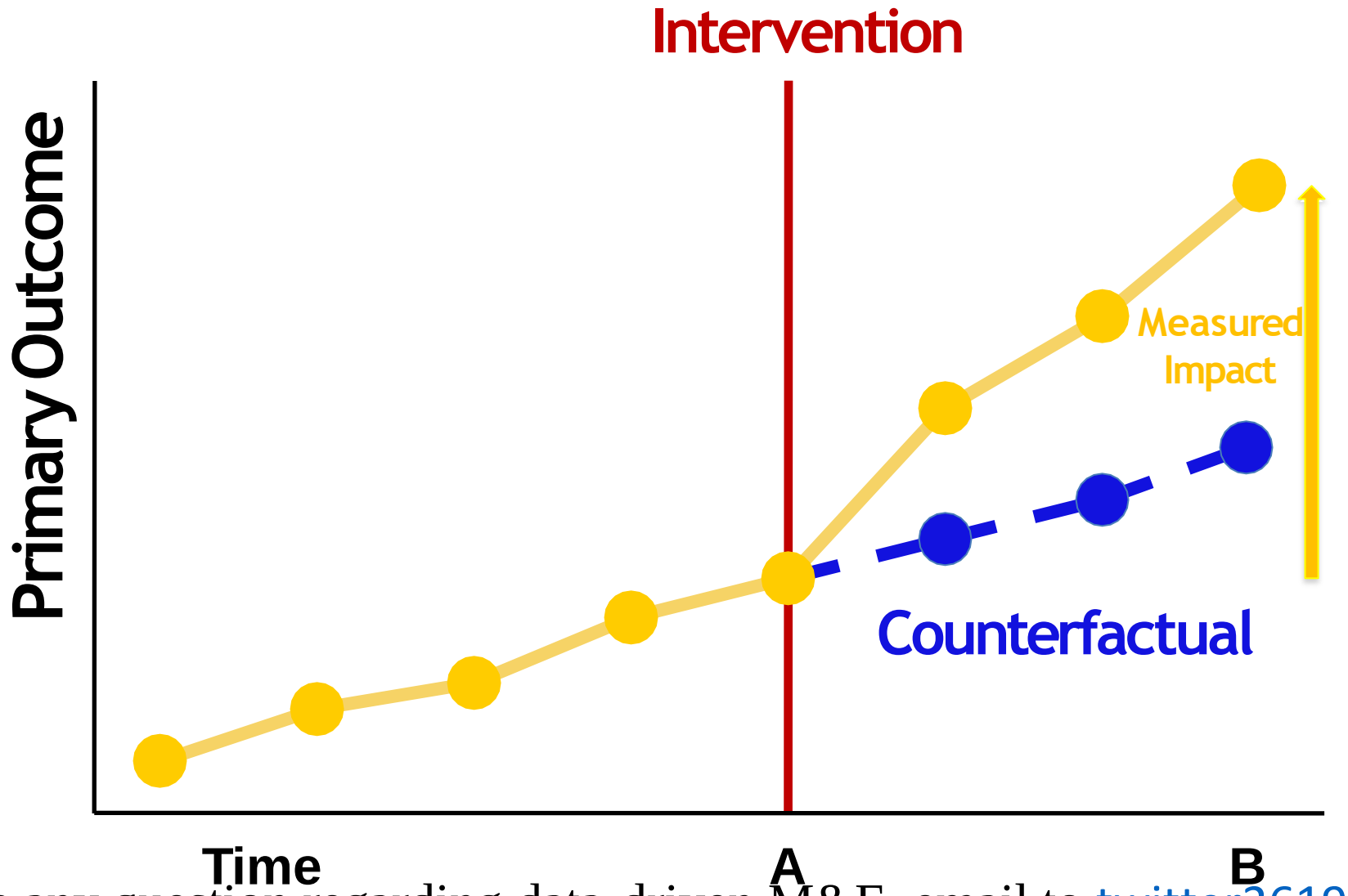
Method 1:Pre-Post



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In this case, how well does pre-post work?

a) Over-estimates impact

b) Under-estimates impact

c) Not enough information

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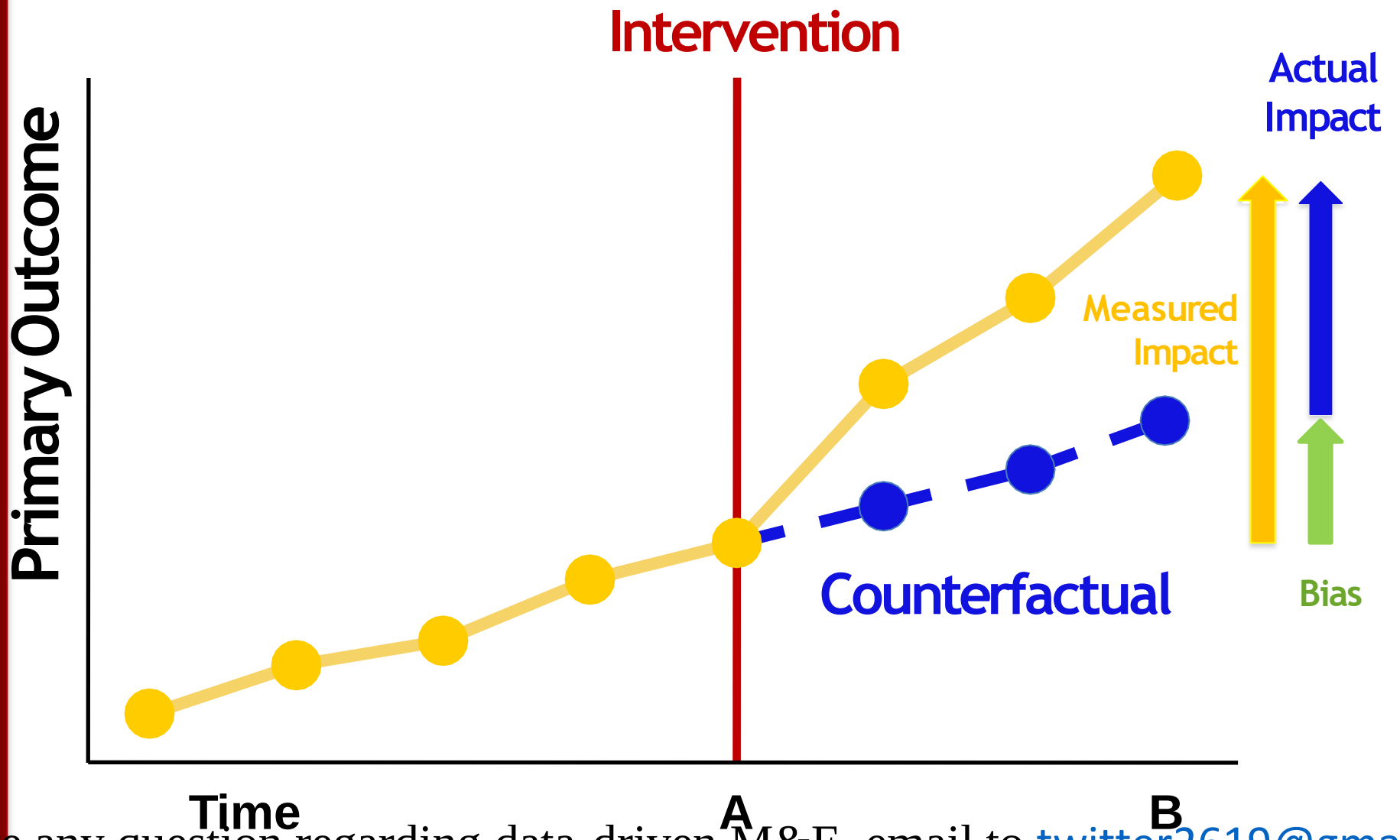
Method 1:Pre-Post



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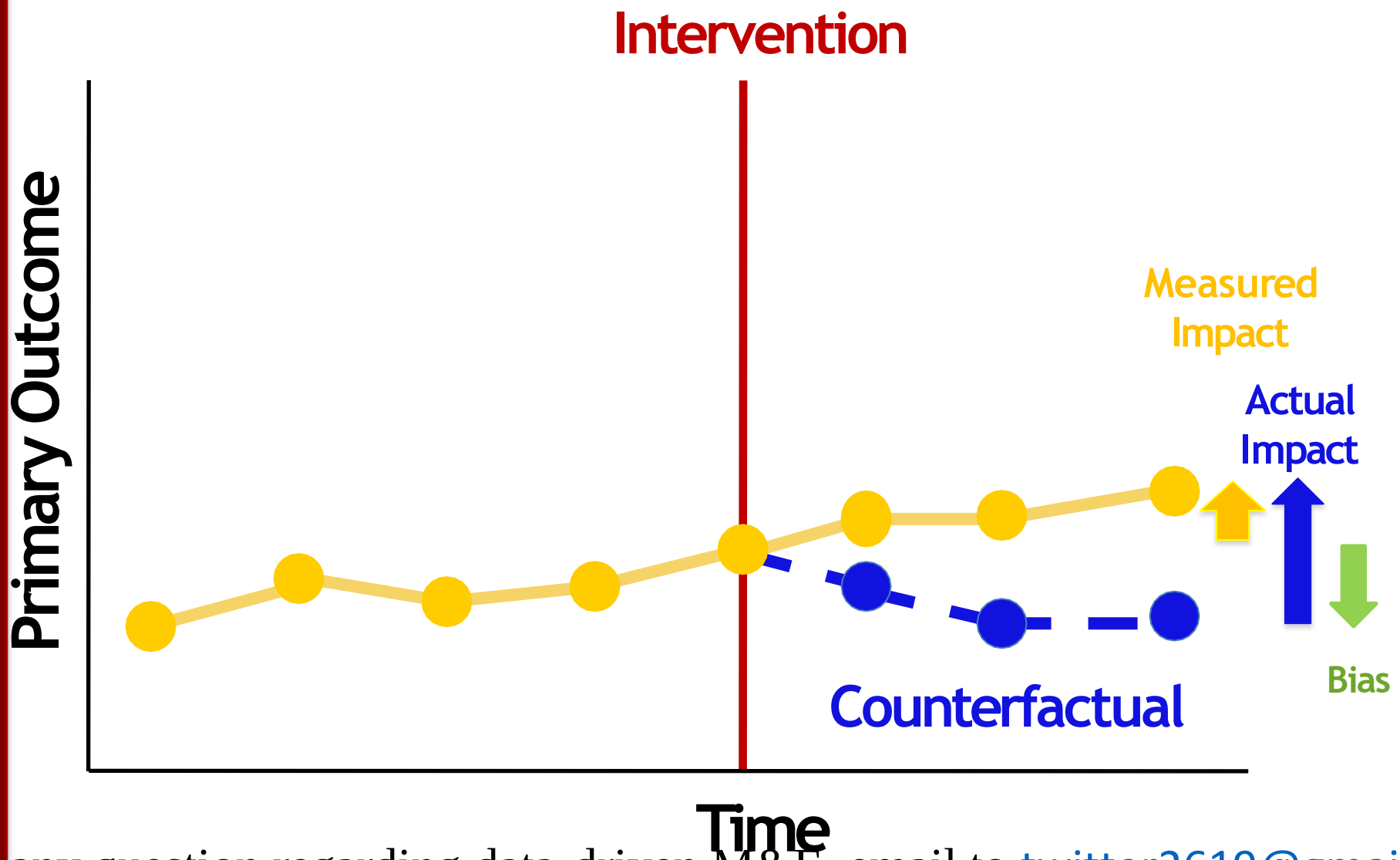

Constructing the counterfactual

- In pre-post, the counterfactual is represented by the **same** group **before** they got the program
- What are the potential problems with this?
  - Other factors contribute to change over time

Pre-post works when you can assume that there were no other factors that contributed to the change in outcomes over time

Impact Evaluation Methodologies

- Evaluate impact through comparing outcomes to a **counterfactual**
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Constructing the counterfactual

- Counterfactual can also be constructed by **selecting a group not** affected by the program

Simple Difference

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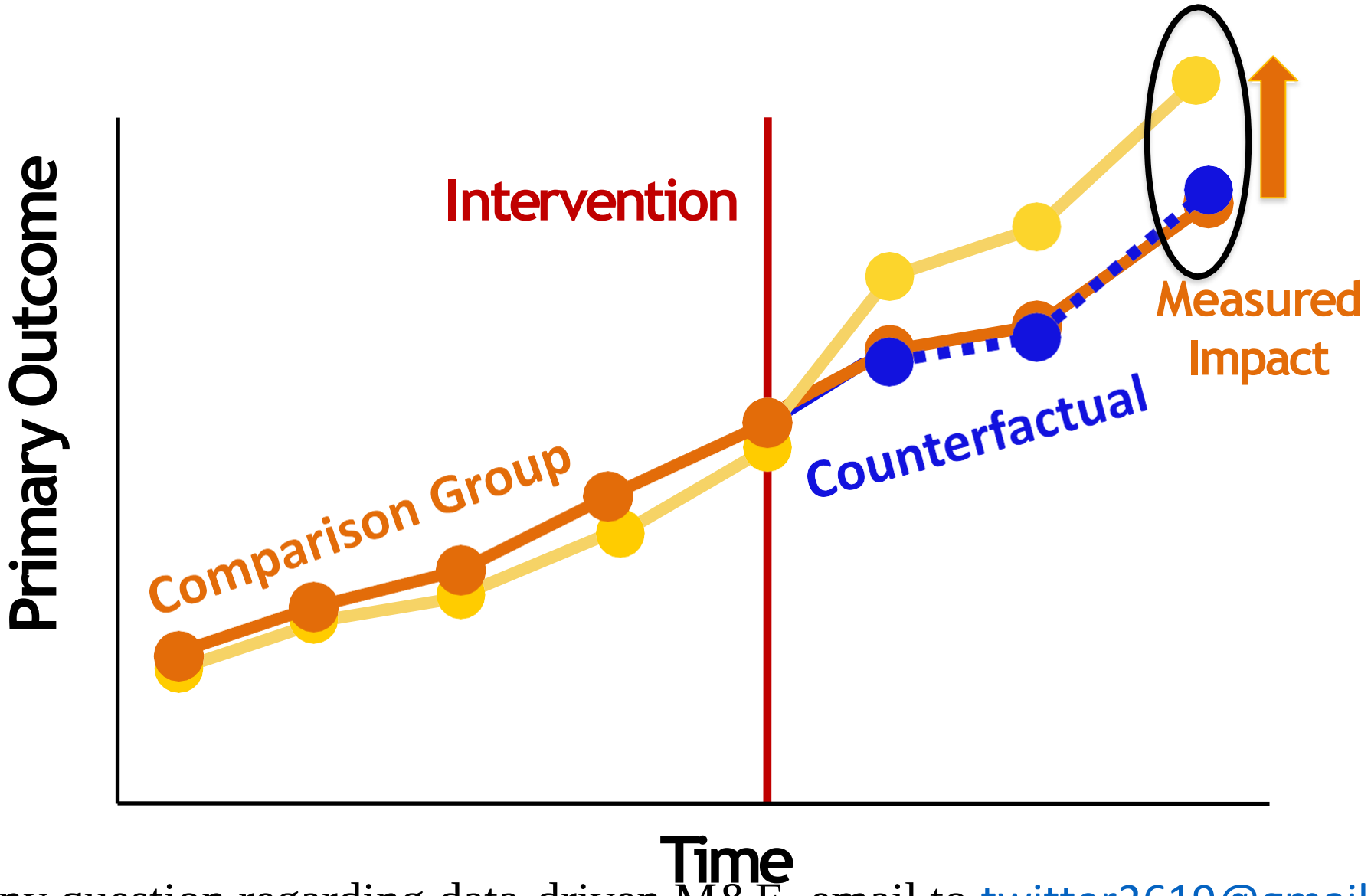
Method 2: Simple Difference



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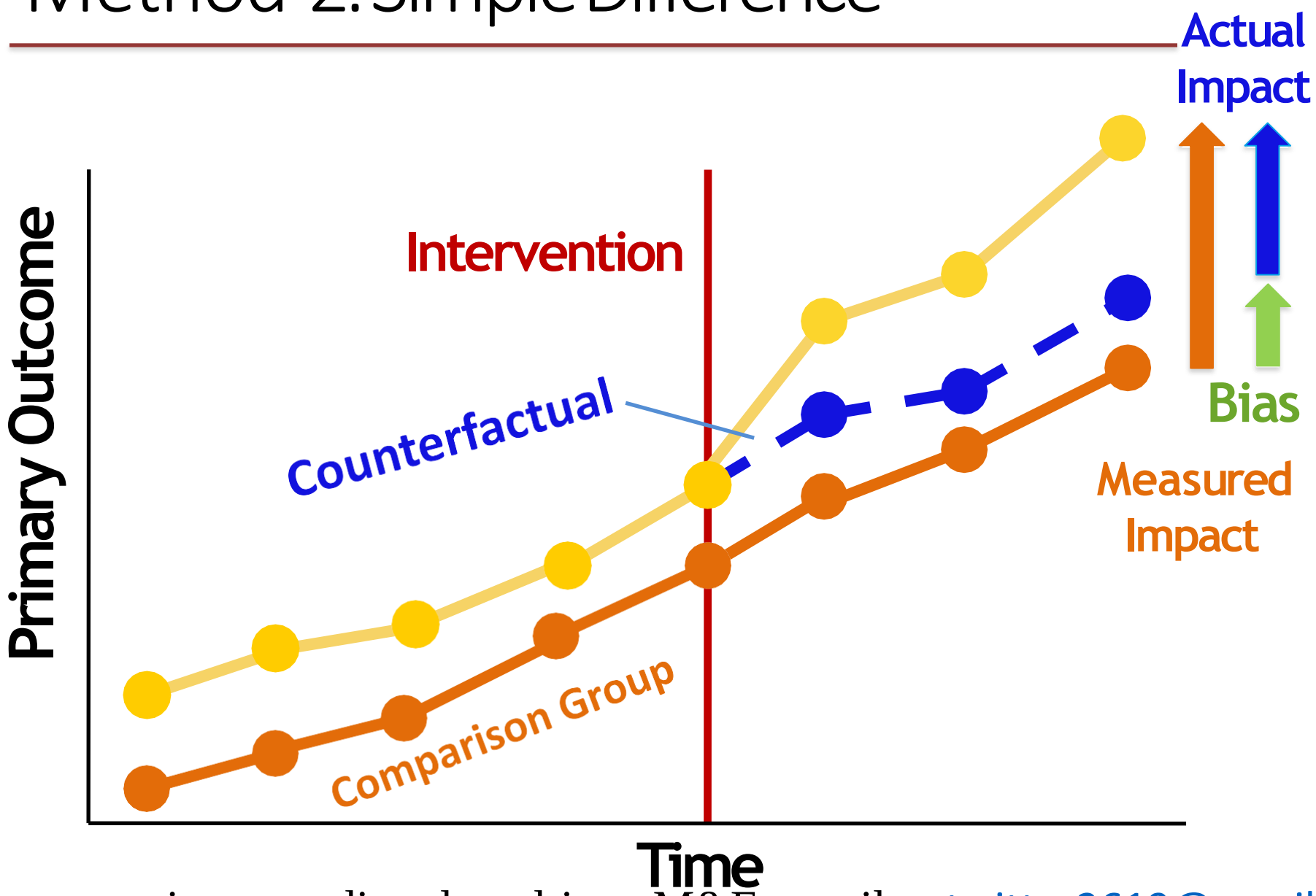
Method 2: Simple Difference



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Simple Difference

- What are the potential problems with this?
  - The comparison group might be inherently different (selection bias or otherwise)

Works when you can assume that non-participants:

1) **Are identical to participants except for program participation**
2) **Were equally likely to enter program before it started**

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Constructing the counterfactual

- Improve the counterfactual by controlling for differences in the two groups **across time**:

Difference in Difference

- Difference in Participants minus Difference in Comparison

  (P2–P1) – (C2–C1) or (P2–C2) – (P1–C1)

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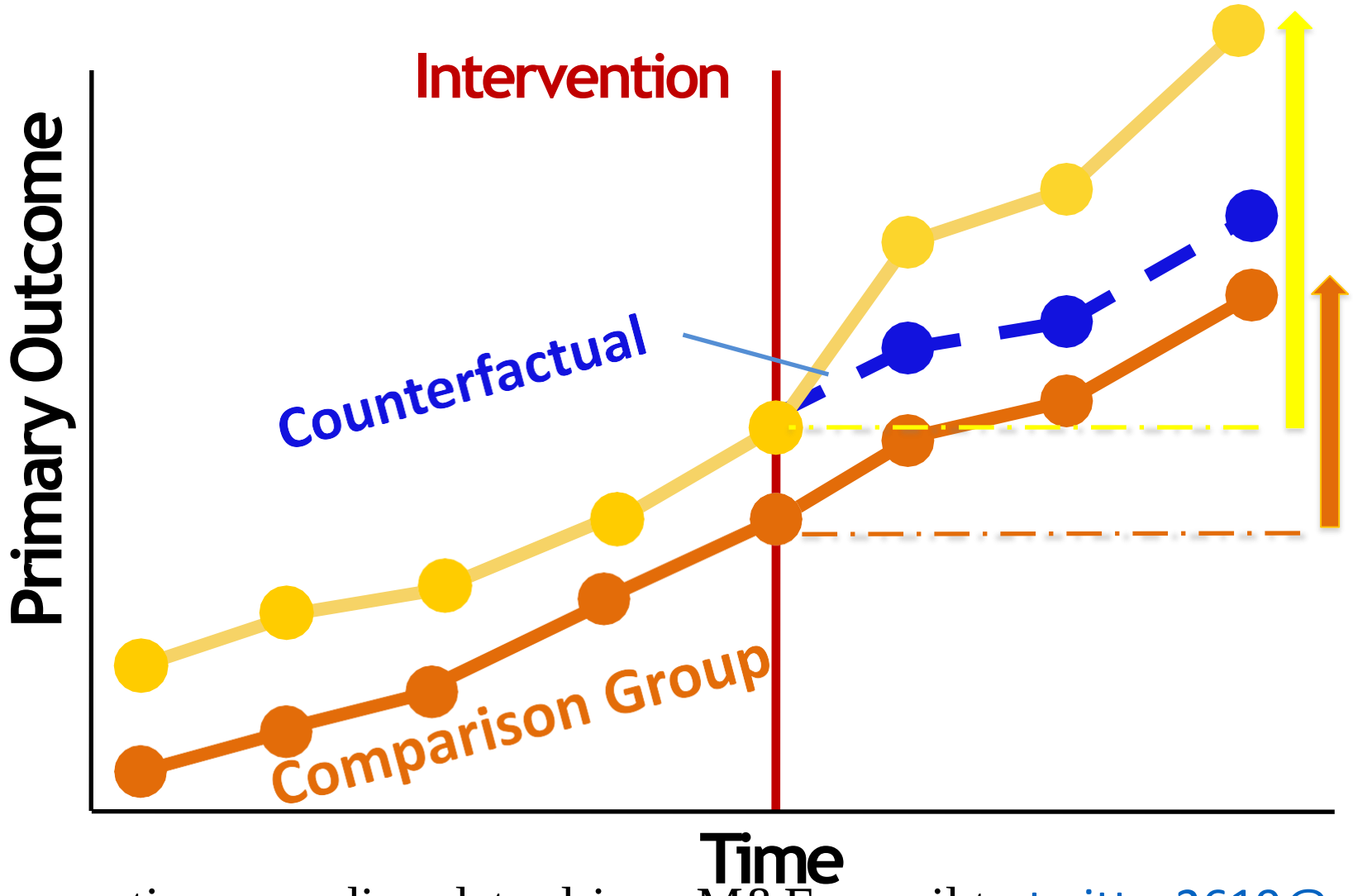
Method 3: Difference-in-Difference



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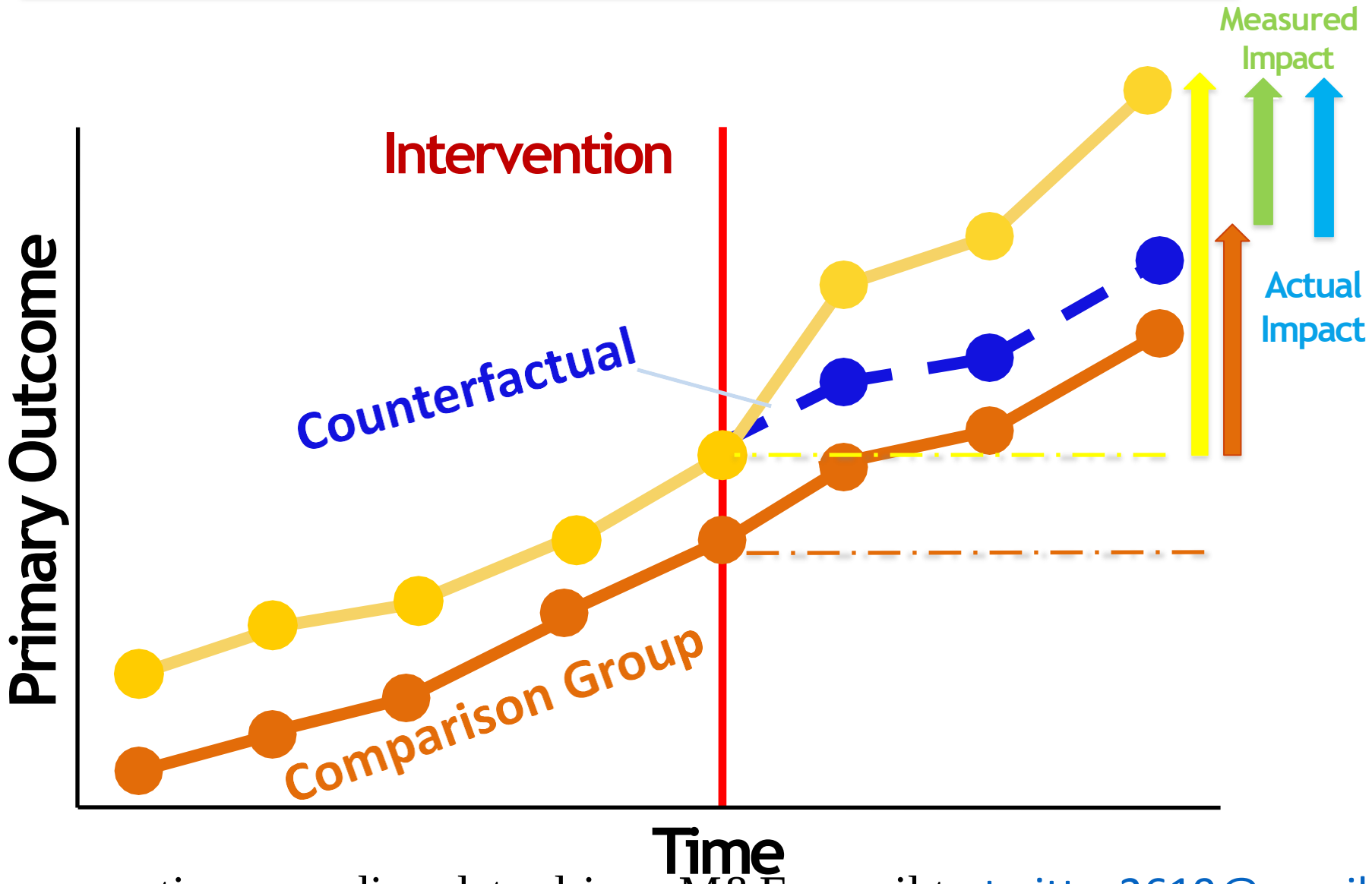
Method 3: Difference-in-Difference



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Difference-in-Difference

- Are there any potential problems with this?
  - Groups may have behaved differently over time
  - Shock to one group and not the other

Works when you can assume that if the program didn't exist, the two groups would have had identical trajectories over this period.

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Impact Evaluation Methodologies

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Regression Analysis

- Special case of simple difference or difference in difference
- Run regression to predict outcome
- Have an explanatory variable indicating if the individual is “treated” or “not treated”
- AND other variables that **could explain a difference** in the outcome or account for selection into treatment.

Works when you have data on all of the other potential explanations.

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Constructing the Counterfactual

- Identify or create a **similar** group for comparison
- The **counterfactual** is often constructed by selecting a group not affected by the program

Non-randomized	Argue that a certain excluded group mimics the counterfactual.
Randomized	Use random assignment of the program to create a control group which mimics the counterfactual.

Randomization: The basics

Start with simple case:

- Take a sample of program applicants
- ***Randomly*** assign them to either:
  - **Treatment Group** – is offered treatment
  - **Control Group** – not allowed to receive treatment (during the evaluation period)

- Note: distinction between offer of treatment and take-up of treatment

Randomization: The basics

Because members of the groups (treatment and control) **do not differ systematically** at the outset of the experiment, any difference that subsequently arises between them can be **attributed** to the program rather than to other factors.

Randomization is often the easiest, most reliable way to create a convincing counterfactual

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Constructing the counterfactual

- Pre-post
- Simple Difference
- Difference-in-Difference
- Randomization

A weaker counterfactual means a greater probability of getting the wrong answer

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Group discussion:

Which method does your NGO apply to M&E?

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An Example: NGO program

- A survey in India found that:
  - 44% of kids between 7-12 could not read a basic **paragraph**
  - 50% could not do simple **subtraction** **despite** being enrolled in school
- In a major city in Gujarat state:
  - Only 19.5% students in Grade 3 could correctly answer Grade 1 math problems

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What are the problems?

- Large class sizes
- Low competency levels in higher classes
- Social gap:
  - Amongst students
  - Between students and teachers
- Teacher absenteeism/pupil absenteeism?
- Poor teaching methods?
- Poor school infrastructure?

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Proposed solution

NGO Program:

1) Hire local teachers (*NGOs*, female)
   - Given training to teach remedial classesin Hindi, Maths, English
2) Identify **lowest** performing students
   - Takethem out of classroom for twohours
   - Ask local teachers to teachthem

Implemented in all 124 Municipal Corporation Schools in the city in Gujarat

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How to measure impact on learning?

1) Select outcome measure – test scores
2) Conduct a test at the **end** of the program
3) Compile Results
   – Students enrolled in the *NGO* program scored an average of 51% marks

What can we conclude from this?

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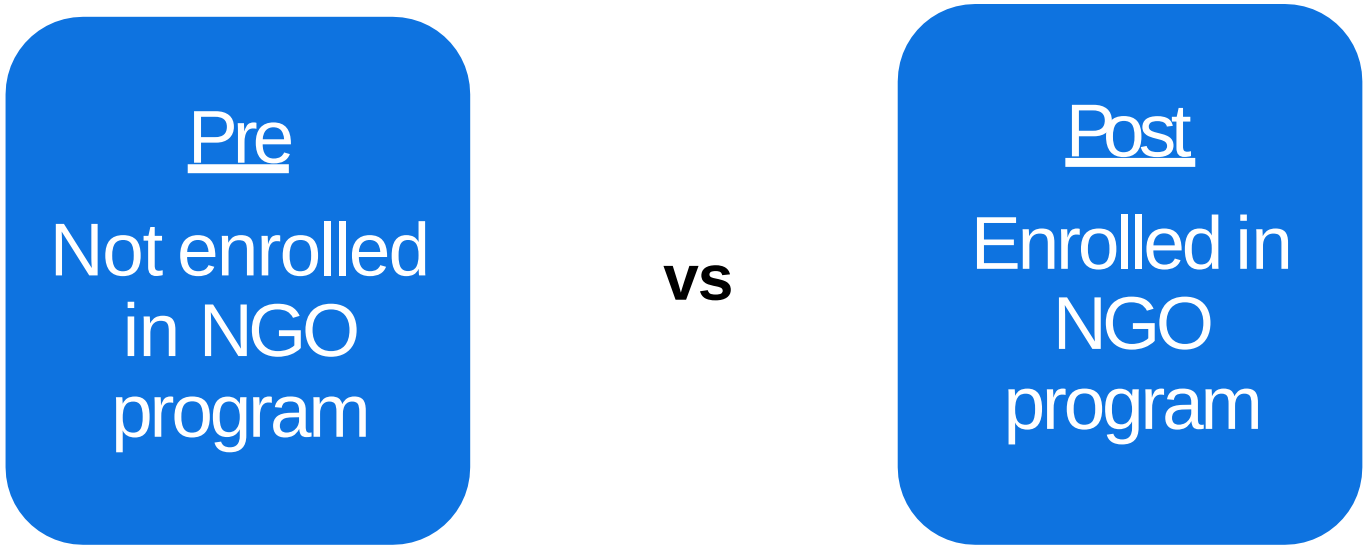
Method 1: Pre Post

- Take the students **enrolled** in the *NGO* program
- Look at their scores at the **start** and **end** of the NGO program



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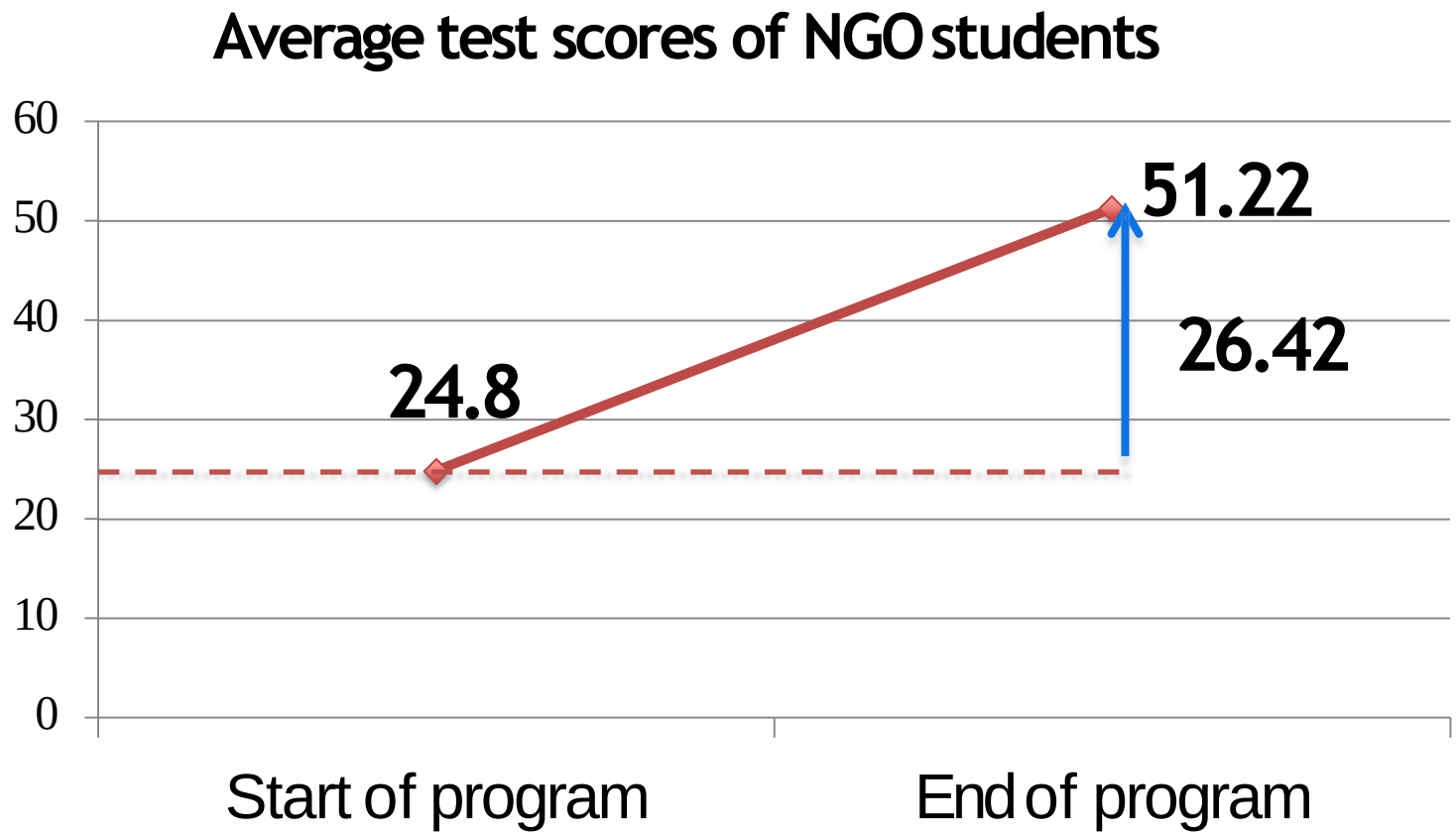

Impact = 26.42 points?

What would have happened without the NGO program?

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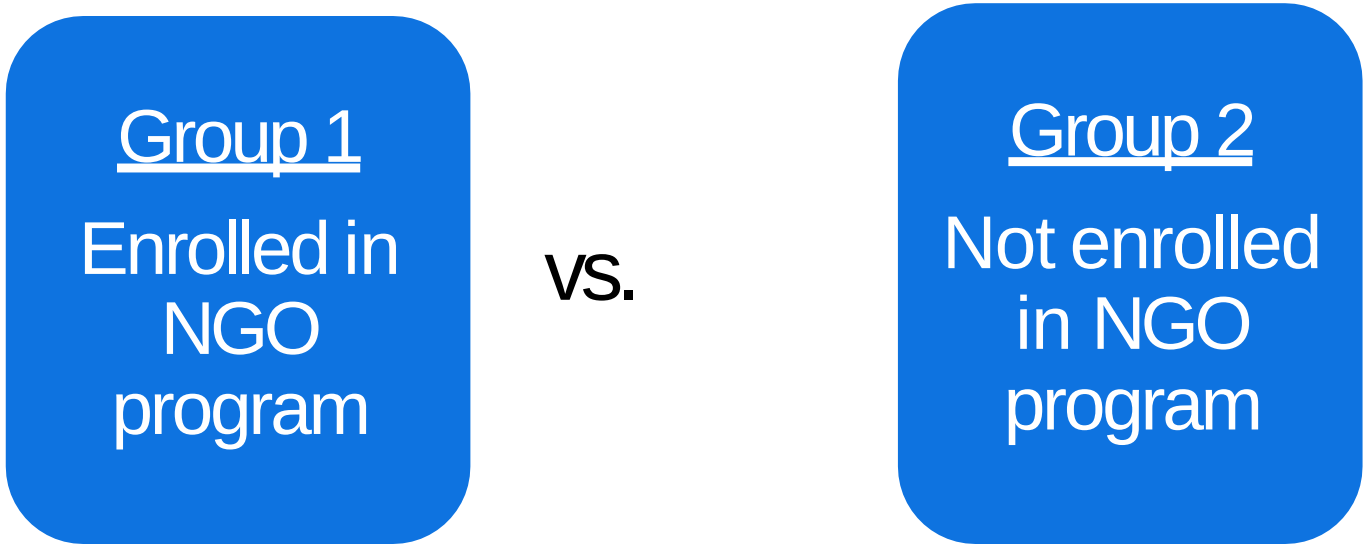
Method 2: Simple Difference

- Find a comparison group to evaluate impact:



- Comparison group should be as similar as possible
- Compare test score of these two groups at the **end** of the program.

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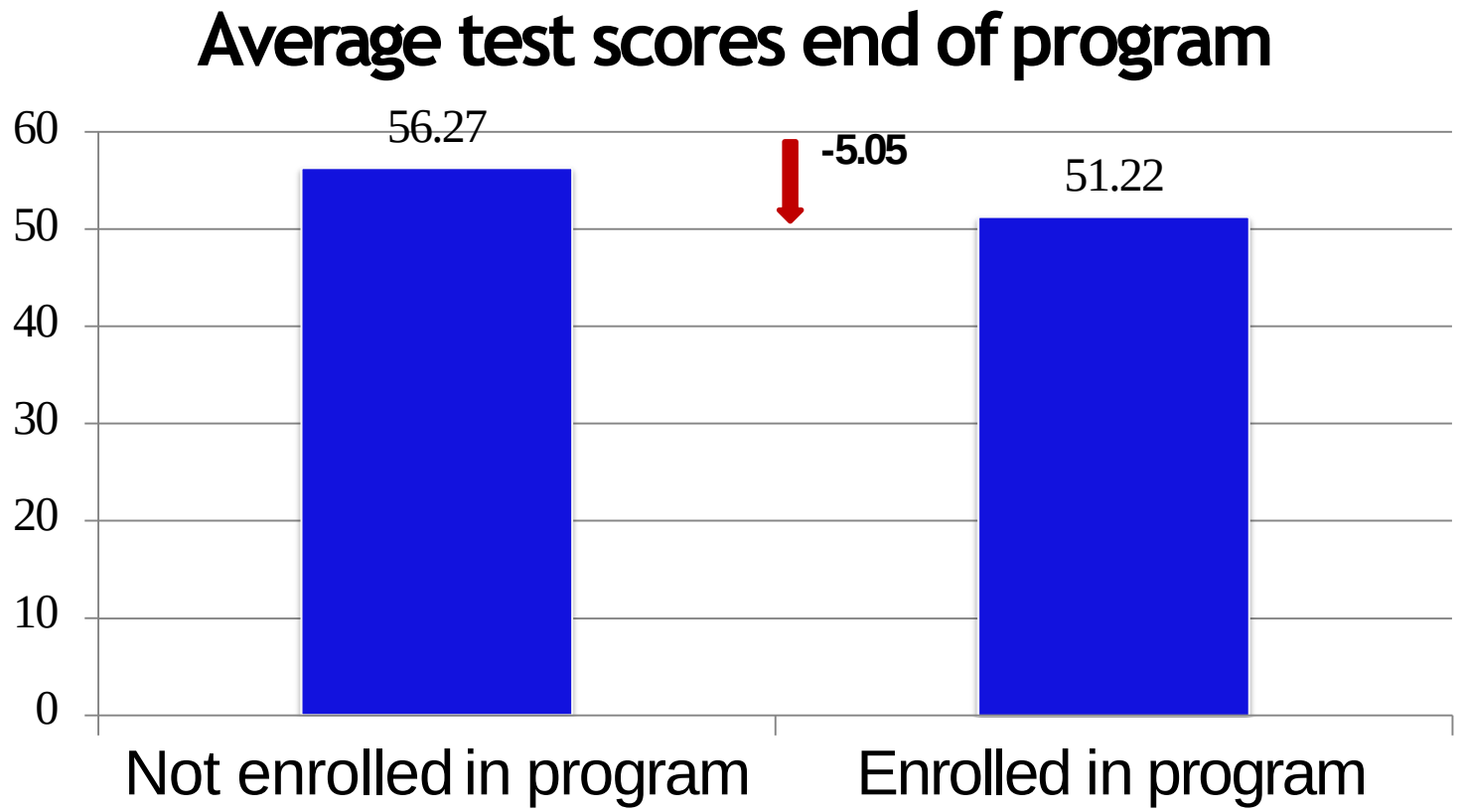
Method 2: Simple Difference



QUESTION: Under what conditions can the difference of **-5.05** be interpreted as the impact of the NGO program?

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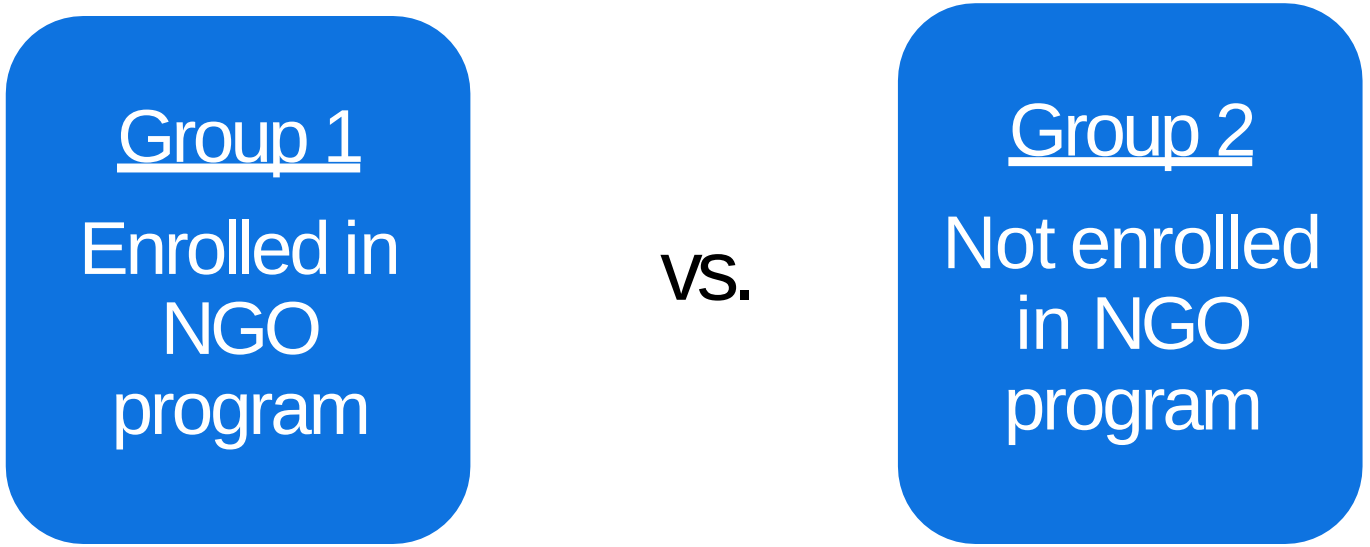
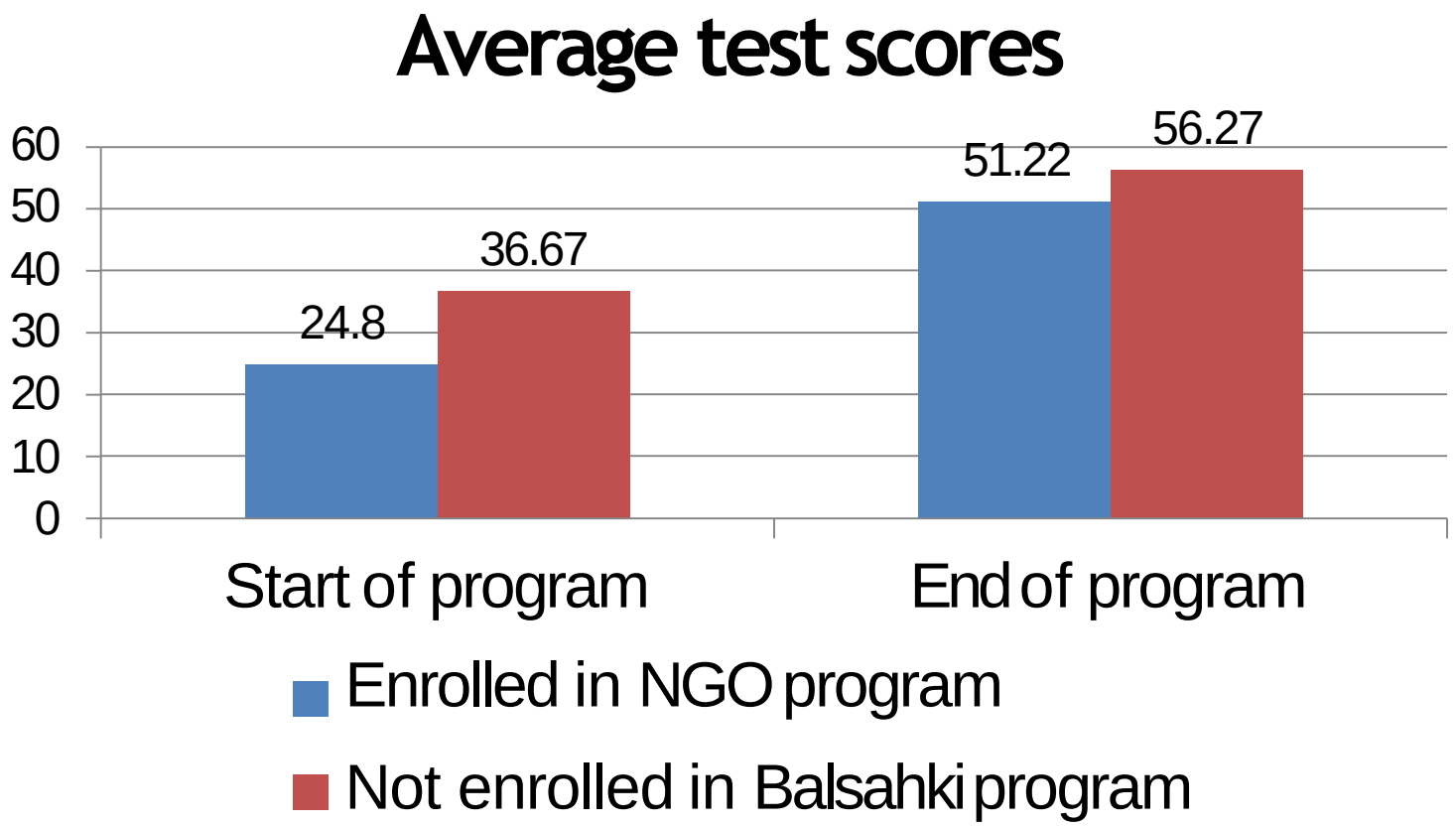
Method 3: Difference-in-difference

- Find a comparison group to evaluate impact:



- Compare test score of these two groups at the **start** and at the **end** of the program.
- Takes into account **pre-program** differences in the two groups

Method 3: Difference-in-difference



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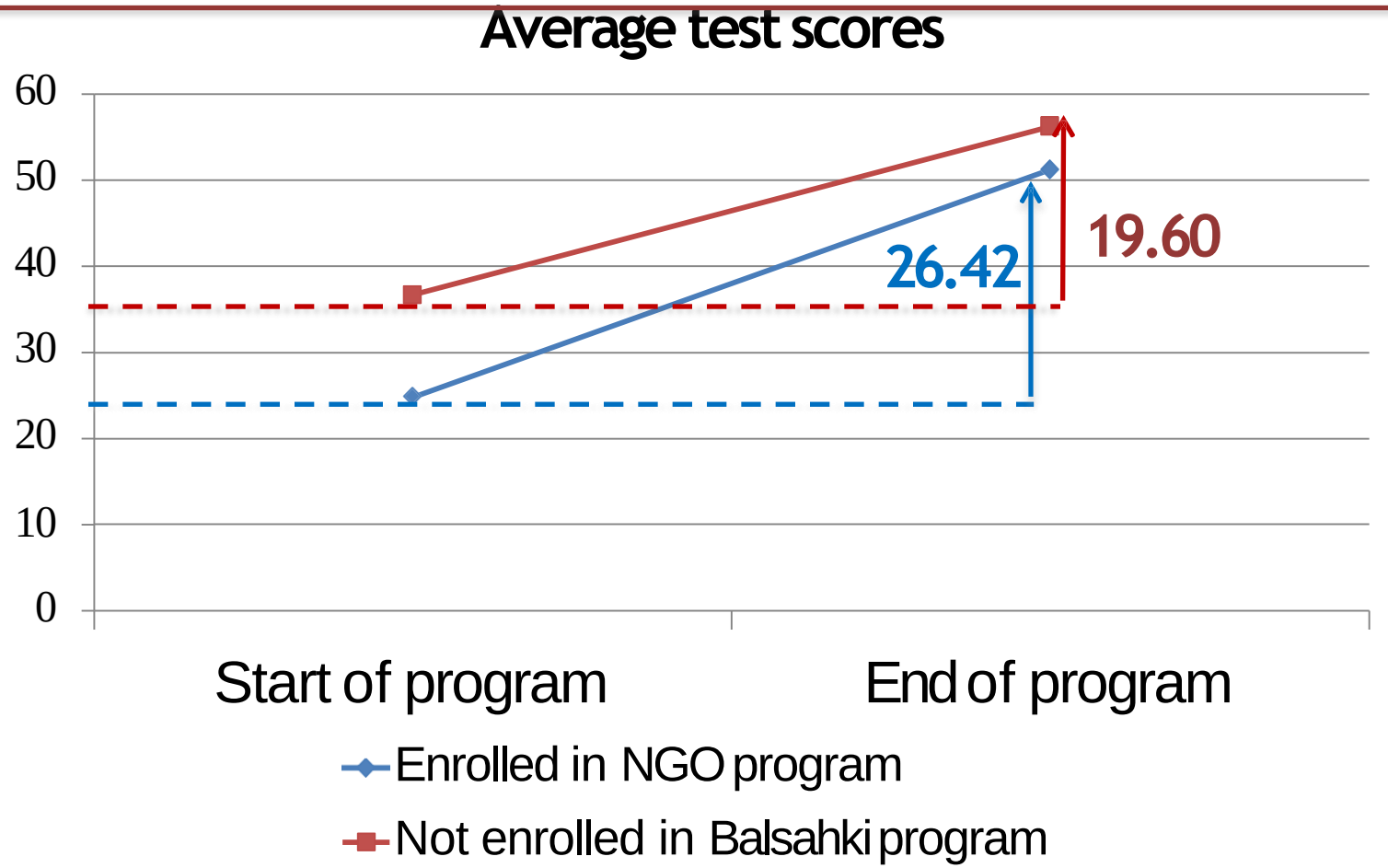
Method 3: Difference-in-difference



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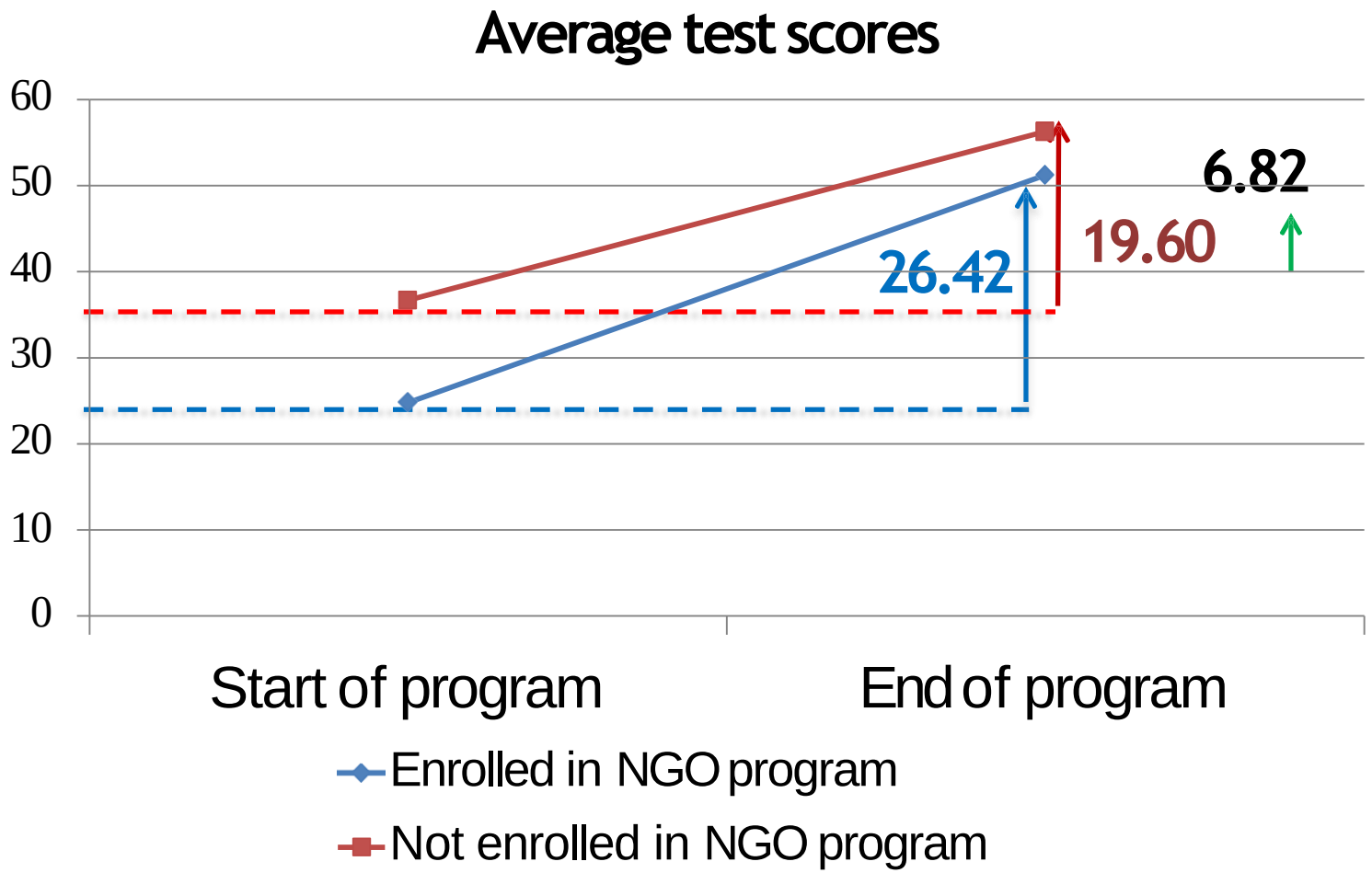
Method 3: Difference-in-difference



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Method 4. Regression Analysis

- Find a comparison group to evaluate impact:

Group 1	vs.	Group 2
Enrolled in NGO program		Not enrolled in NGO program

- Compare test score of these two groups at the **start** and at the **end** of the program.
- **Control** for additional variables like gender, class-size

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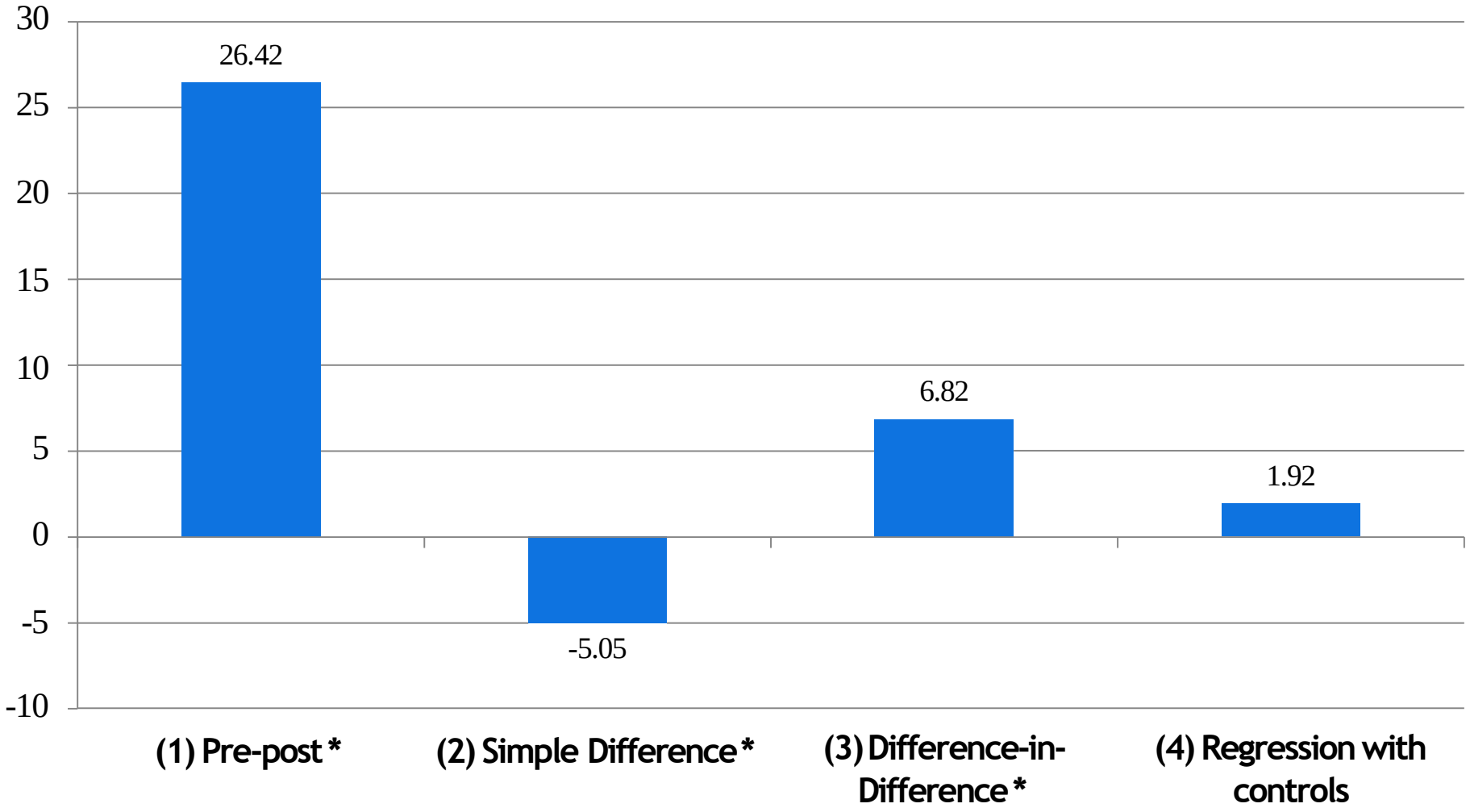
Impact of NGO program



* Significant at 5% level

Conclusion

Measuring impact is all about finding a convincing representation of the counterfactual

- **Identify or create a group that mimics the counterfactual**
- **Always test your assumptions:** What else might be causing the measured impact?
- **Randomization** is often the easiest way to create a reliable counterfactual

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Contact us any time

twitter2619@gmail.com

Thanks very much!