Chapter 4
Randomization

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Outline

1. **What can be randomized?**
2. What are the opportunities?
3. Choosing the level of randomization
4. Steps in simple assignment
5. Stratified & pairwise randomization
6. Which aspects can be randomized?

What can be randomized?

- Three aspects of programs
  - Access: which people will be offered access
  - Timing of access: when access is provided
  - Encouragement : which people will be given encouragement to participate

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When is possible to perform a randomized evaluation?

1. New program design
   - When a problem has been identified but there is no agreement about what solution to implement
2. New programs
   - When a program is new and being pilot- tested
3. New services
   - When an existing program offers a new service

When is possible to perform a randomized evaluation?

4. New people/ location
   - When there are not enough resources to cover all new clients/ areas
5. Oversubscription
   - When there are more people than the program can serve
6. Under subscription
   - When program is serving fewer people than it could

When is possible to perform a randomized evaluation?

7. Rotation
   - When the program's benefits or burdens are to be shared by rotation
8. Admission cutoffs
   - When the program has a merit cutoff and the cutoff can be randomly admitted
9. Admission in phases
   - When the program doesn't have enough logistical capacity and resources to serve everyone at once and people can be randomly admitted in phases over time

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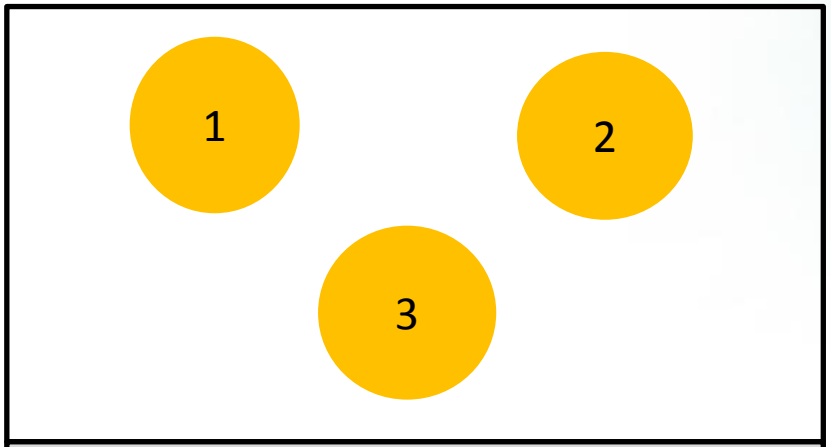
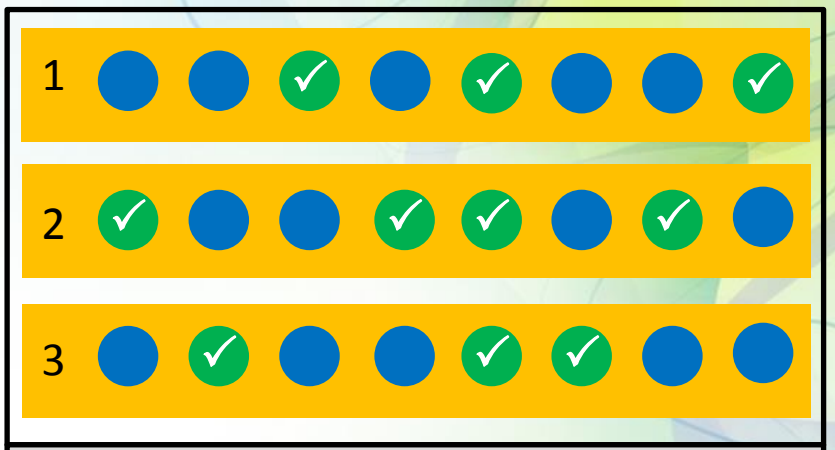
Choosing The Level of Randomization

- Two levels of randomization evaluation:
  - Individual
  - group

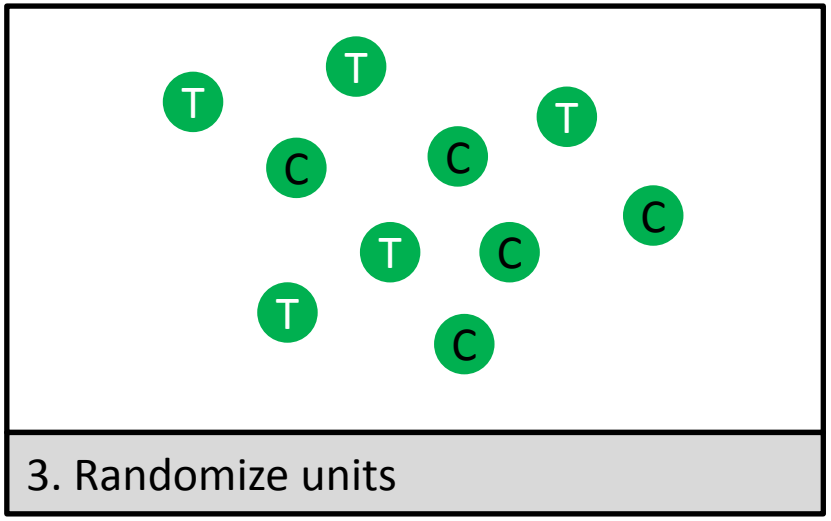
Individual-level Randomization



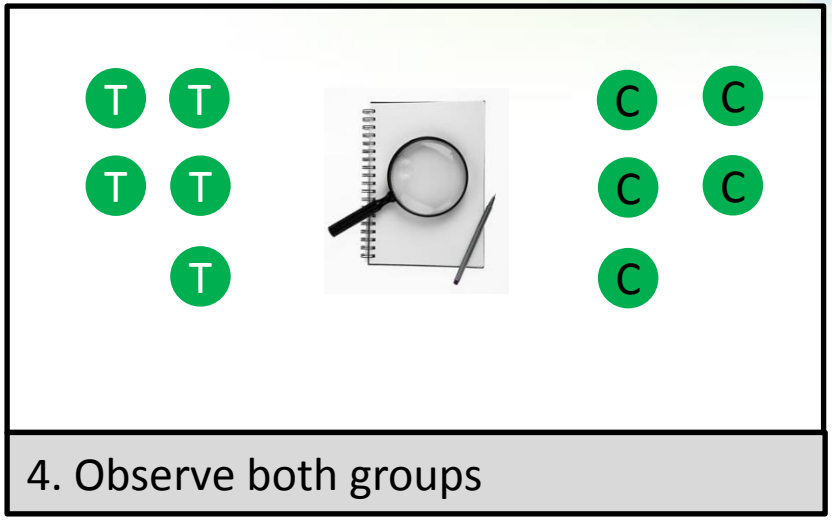
1. Select study sites



2. Apply eligibility criteria

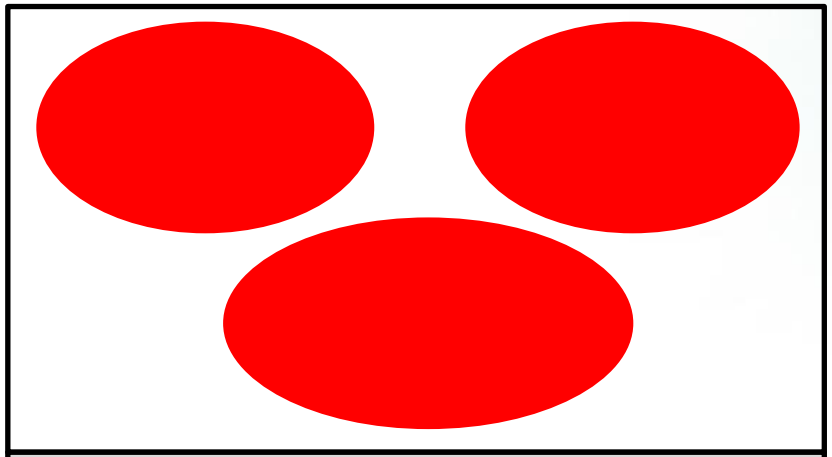


3. Randomize units



4. Observe both groups

Group-level Randomization



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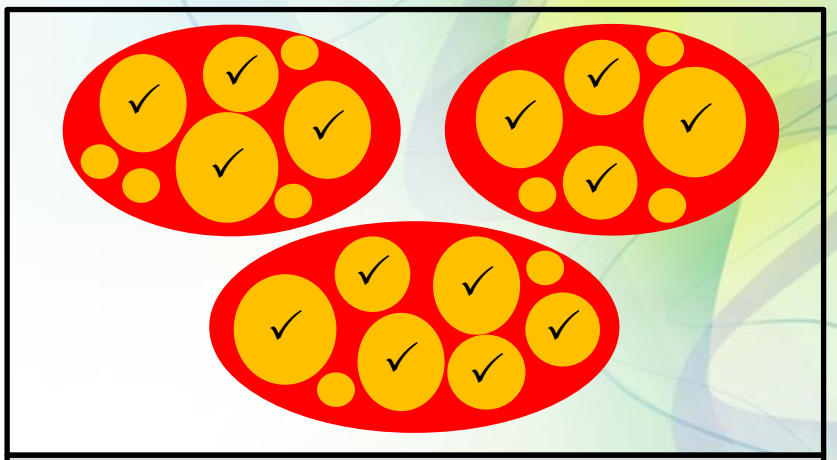

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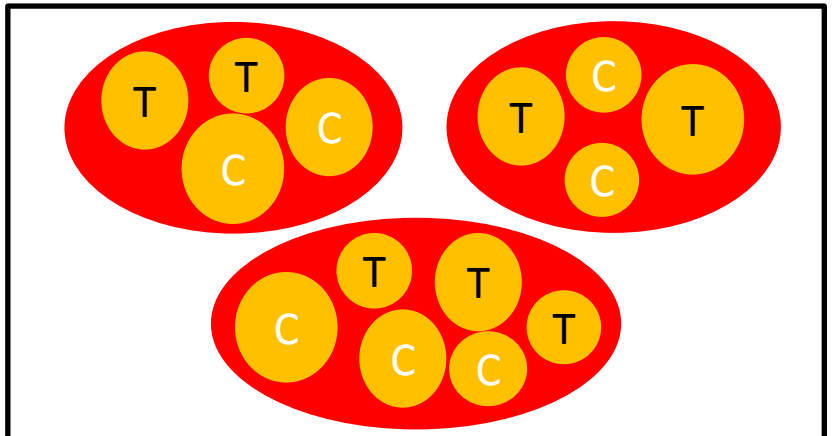
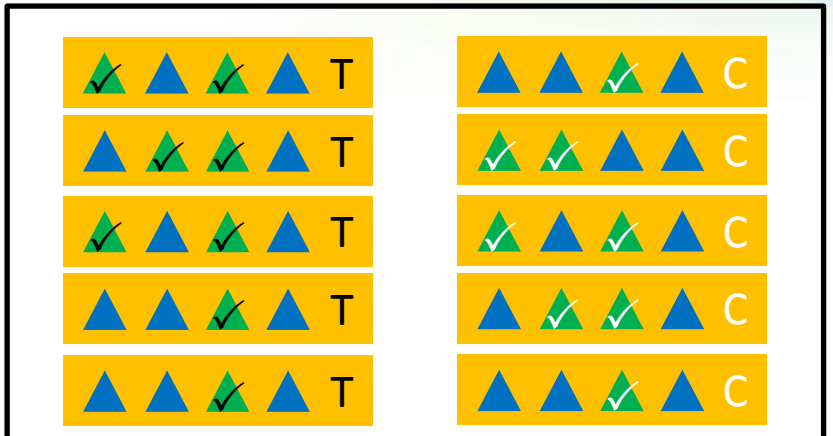


3. Randomize groups



4. Observe a random sample of people

Technical & Non-technical Considerations

1. Unit of Measurement
2. Spillovers
3. Attrition
4. Compliance
5. Statistical Power
6. Feasibility

Unit of Measurement

- The level of randomization needs to be the same or higher than the level at which the outcome will be taken.
- Example: The effects of employee training on firm's profit

Spillovers/Externalities

- What are spillovers?

  Behavioral, Information, Physical, Market wide/ Equilibrium

- Why do spillovers matter?

  Dependency between the outcome of treatment and comparison group

- How to choose the level of randomization to limit spillovers to the comparison group?

  Choosing a unit of randomization so that the most relevant interaction occurs within the group

Attrition

- What is attrition?

  An event when the outcome is missing for some reasons

- What are the causes of attrition?
  - Subject is not assigned their preferred treatment.
  - Program is too long and onerous.

- Can randomizing reduce the attrition?

  Randomizing at higher level might help reduce attrition.

Compliance

- Who are expected to comply with the experiment?

  Program (field) staff, subject

- How to increase the compliance?
  - Prevent any confusing situation for staff that may lead to a difficult situation
  - Involve people around the subject to join the program

- Can randomizing increase the compliance?

  Randomizing at the level of staff might increase the staff compliance.

Statistical Power

- The larger the number of randomized units, the higher the statistical power.
- Which one has more statistical power between individual and group level randomization?

  Individual > group
- Why does group level randomization have less statistical power?

  The outcome of subjects within the same group are not fully independent.

Feasibility

- Ethics: randomization should be done in a way that does not create tensions or bring harm to the subject.
- Politics: randomization should get a permission from authorities.
- Logistics
- Cost

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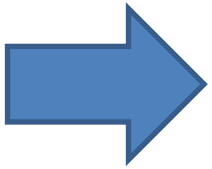
5. Stratified & pairwise randomization
6. Which aspects can be randomized?

Step in simple assignment

1. Order the list of eligible units

ID	Label
A	0.825325
B	0.528554
C	0.64382
D	0.017801
E	0.875285
F	0.512279
G	0.41086
H	0.985281
I	0.436026
J	0.858813
K	0.881948
L	0.457461
M	0.874966
N	0.960646
O	0.650178
P	0.799982
Q	0.67447
R	0.448206
S	0.15039
T	0.24563

sort



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M	0.874966
E	0.875285
K	0.881948
N	0.960646
H	0.985281

- The list is based on unique random numbers
- Sort the list in ascending or descending order

Step in simple assignment

2. Allocate units to different groups
   - According to intervals, percentile, odd- even
3. Randomly choose treatment groups
   - By flipping a coin or using random number
   - It is important to determine all procedures before start

Step in simple assignment

4. Balance check
   - Using t-test
   - Whether the groups are significantly different from each other or not
   - The treatment group and the comparison group must not be significantly different
   - Only if the variable which is significantly different is not a major factor to affect the program, you can ignore it

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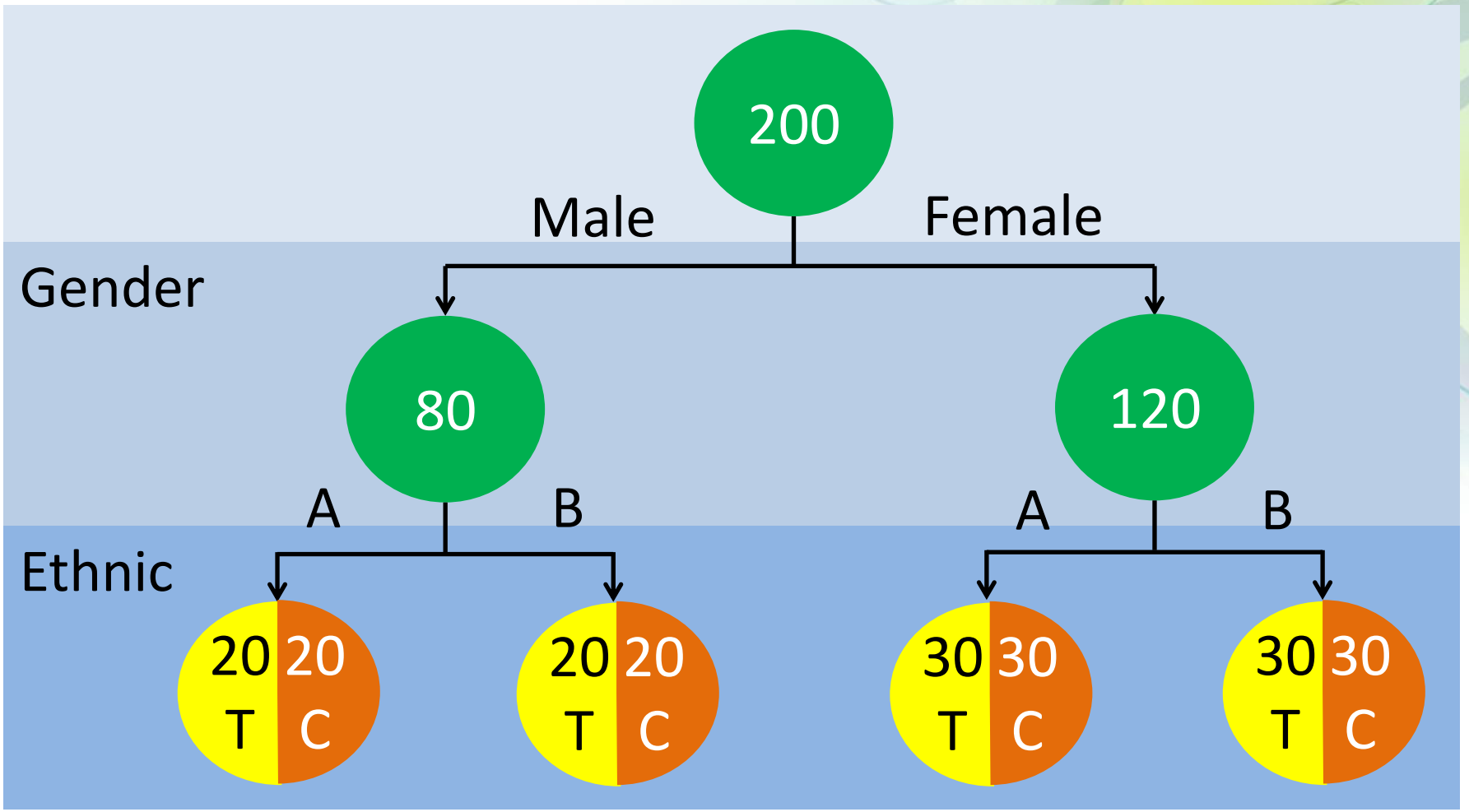
Stratified Randomization

- What is stratified randomization?

  A way in randomization to ensure that the treatment and comparison groups are balanced on key variables.

How to Stratify?

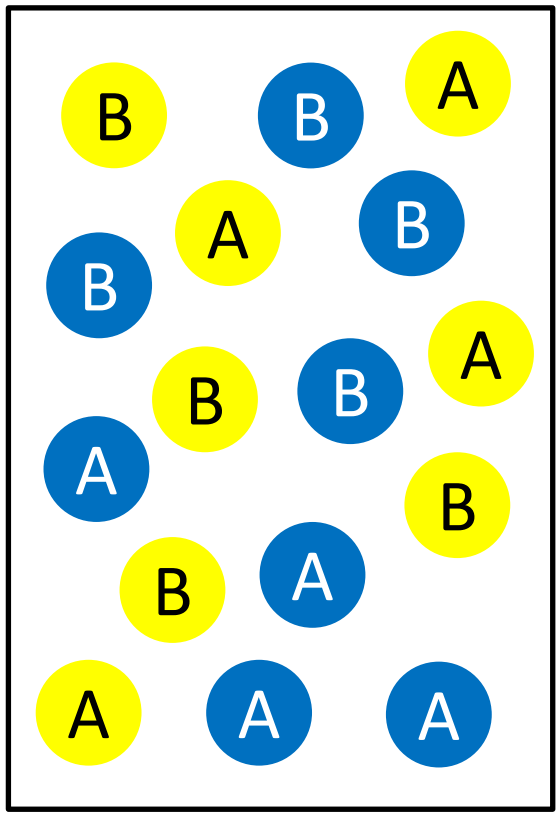


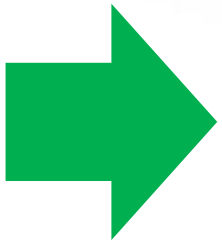
Other Aspects of Stratified Randomization

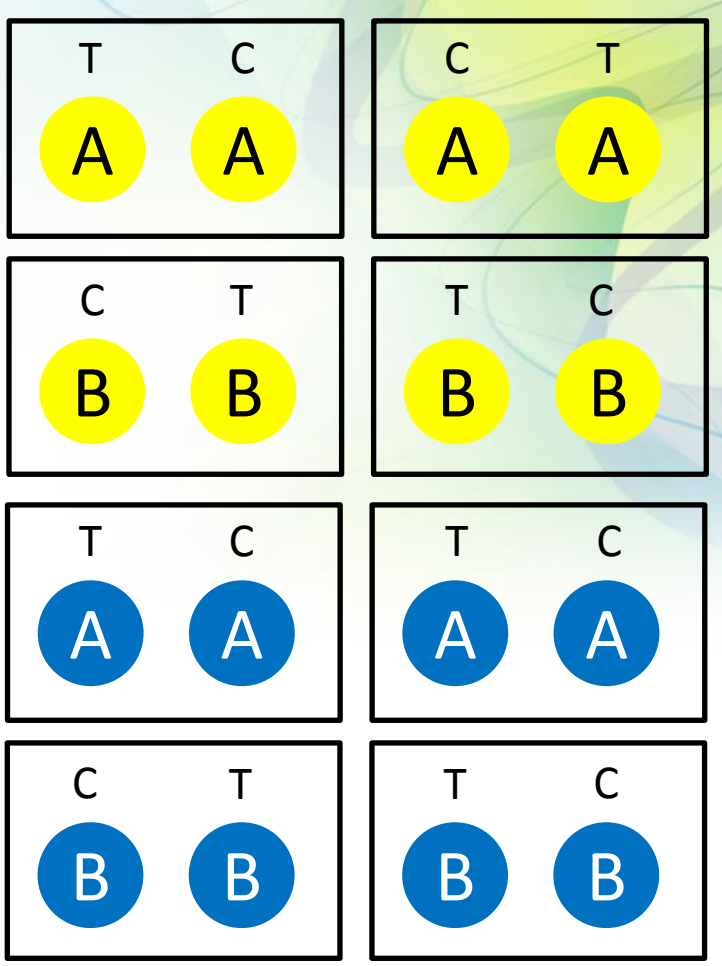
- When is stratified randomization most useful?
  - Achieve the balance
  - Increase the statistical power
  - Analyze the impact by subgroup
  - Balance for political or logistical feasibility
- Which stratification variables should be used?
  - Discrete value
  - Highly correlated with the outcomes of interest
- How many variables to stratify on?

  Stratum size, practicability, and loss of power

Paired Random Assignment







●/● : male/female

A/B : Ethnic A / B

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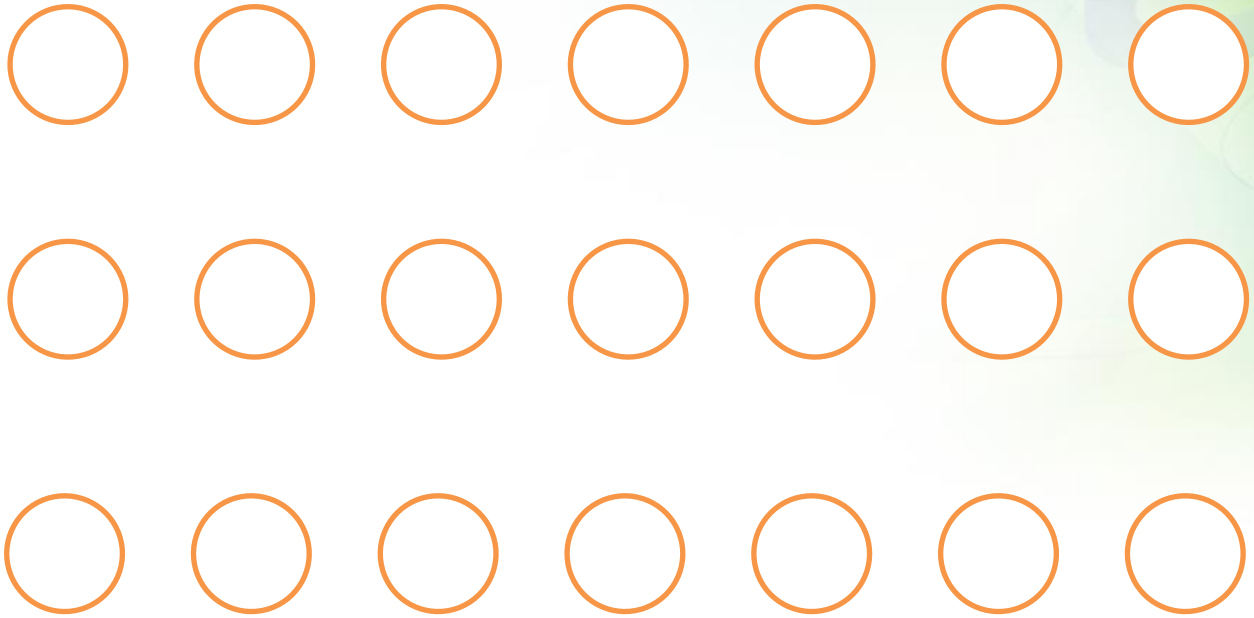
Designs of Randomization

- Access
  - Treatment lottery
  - Treatment lottery around cutoff
- Timing of Access
  - Phase-in
  - Rotation
- Encouragement

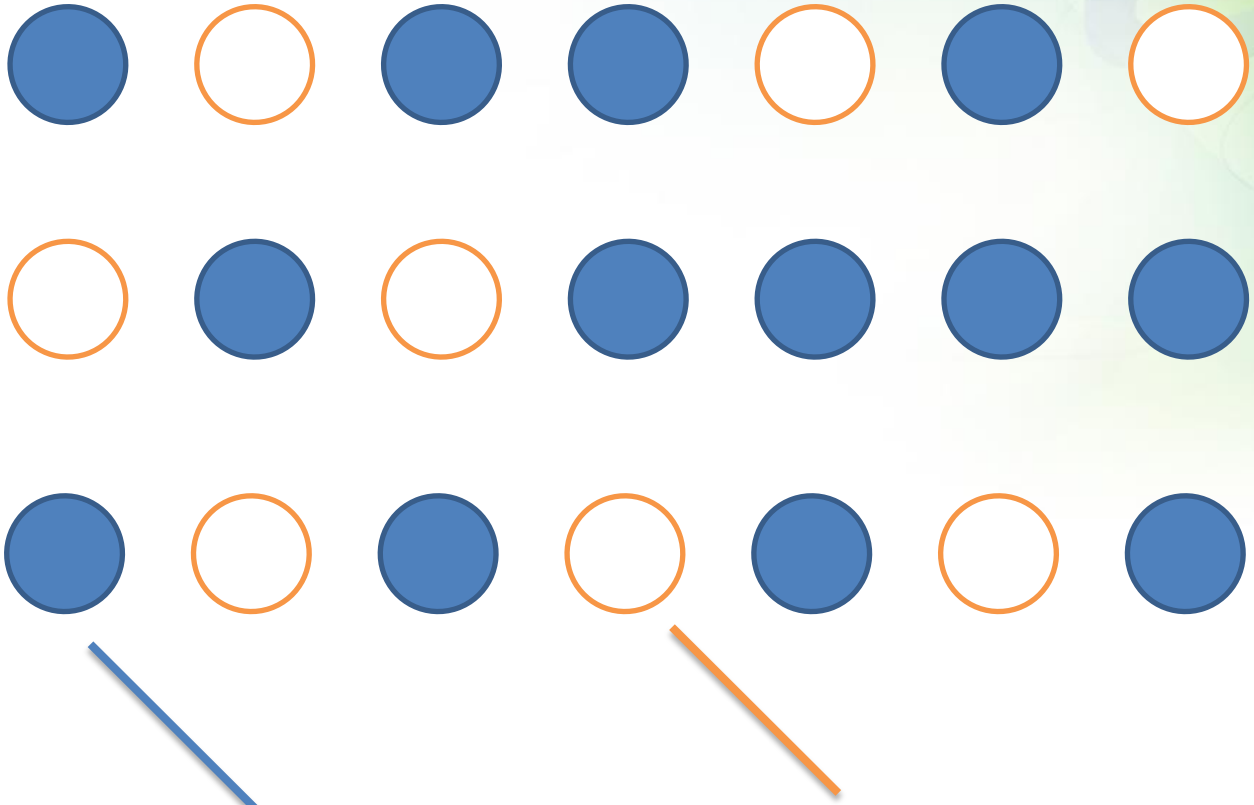
Treatment Lottery

- When
  - Limited access, over-subscribed
  - Measure effects in the long-run
- E.g. Extra Teacher Program in Kenya
  - 120 teachers
  - 210 schools

Treatment Lottery



Treatment Lottery

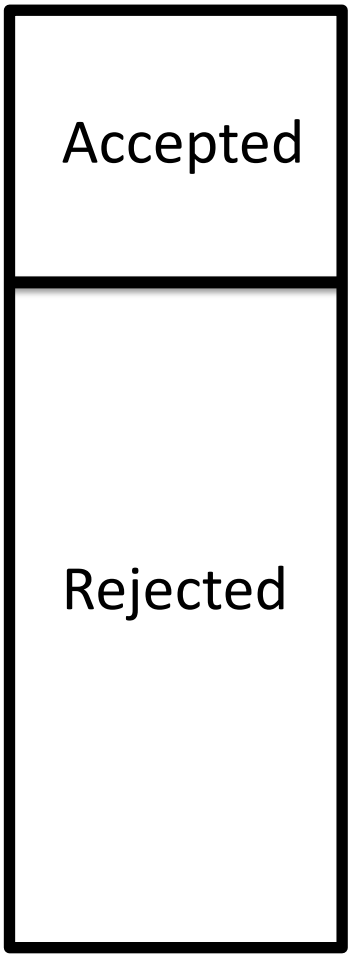


Treatment Lottery

- Notice
  - “Entitlement program”
  - Higher attrition levels

Treatment Lottery around Cutoff

1.



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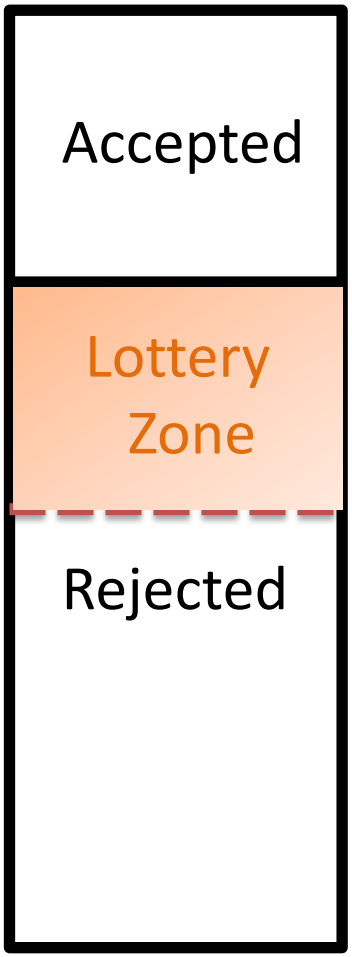

Treatment Lottery around Cutoff

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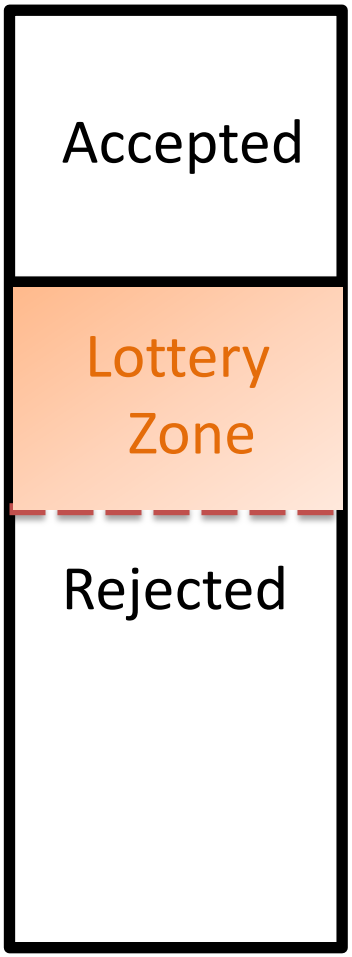

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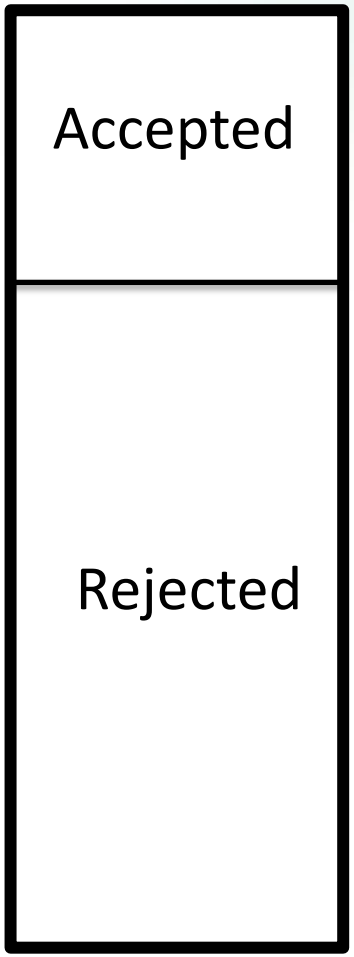

Treatment Lottery around Cutoff

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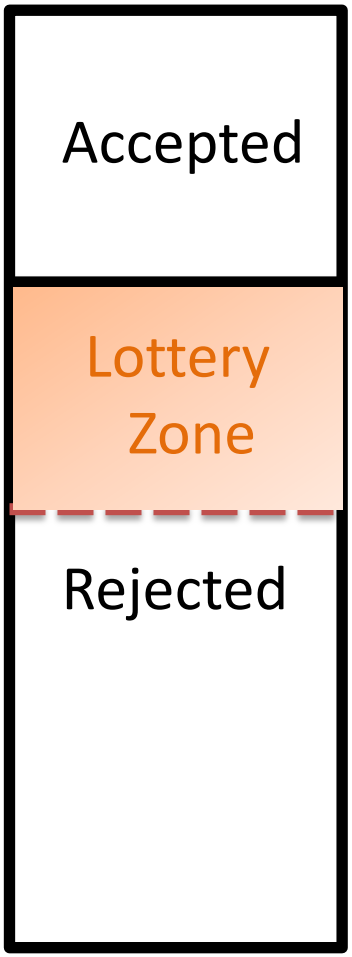

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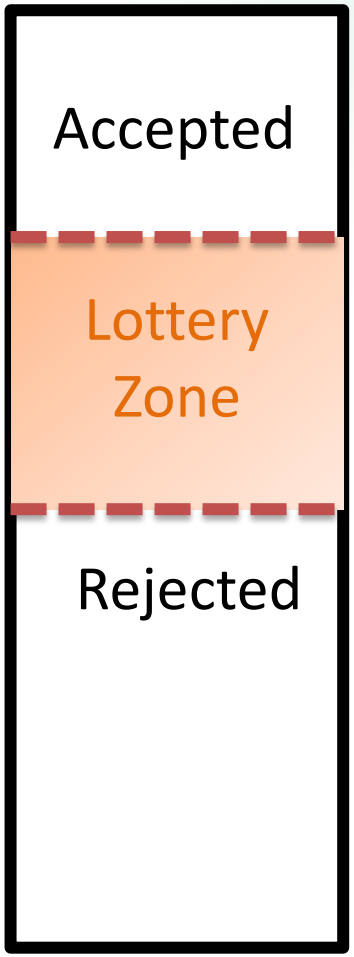

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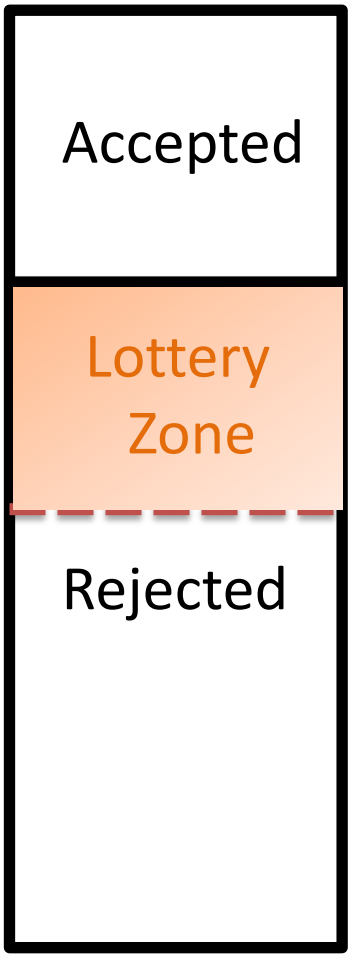
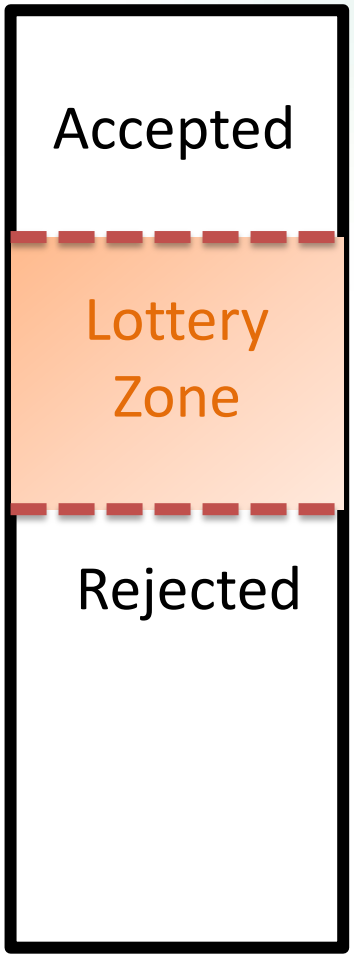


2.



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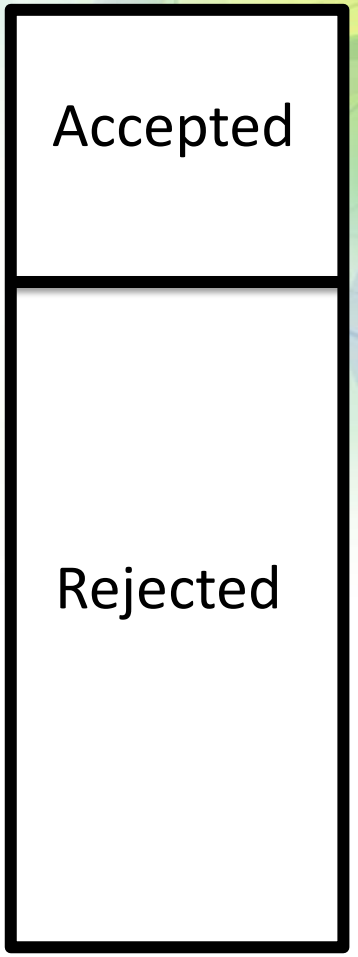

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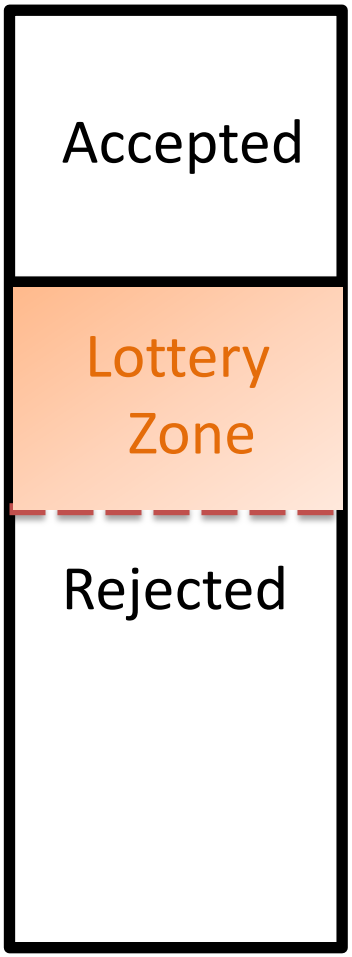

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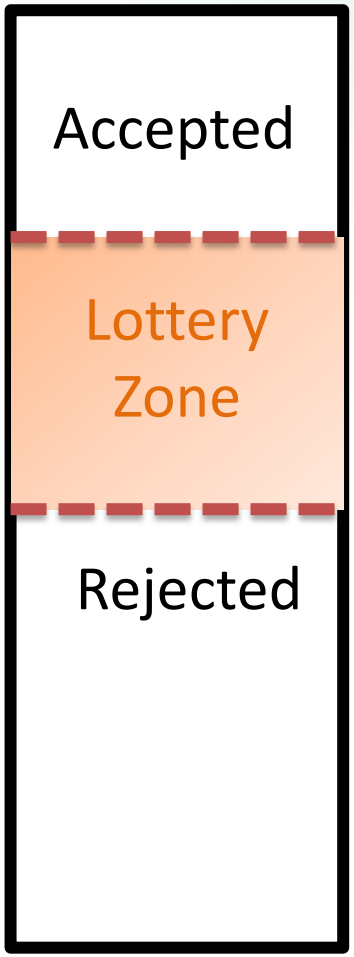

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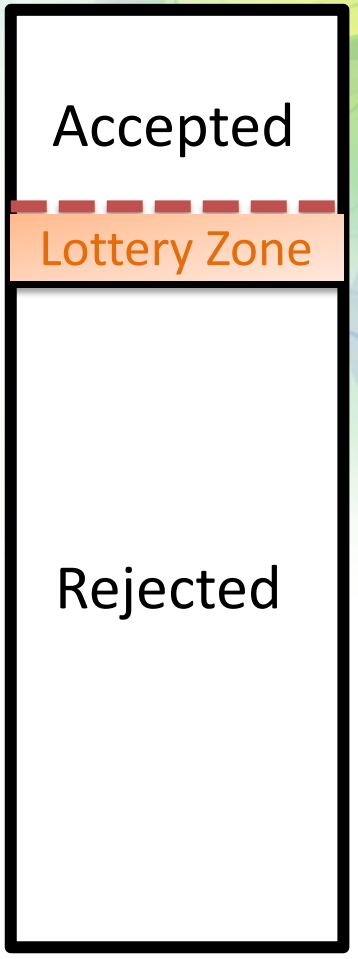
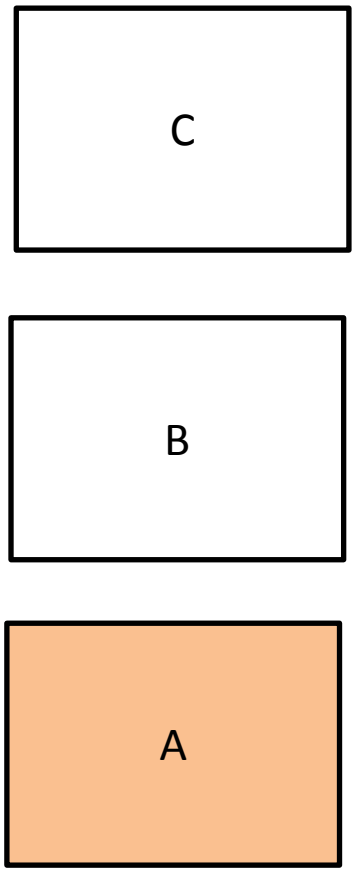


Phase-in

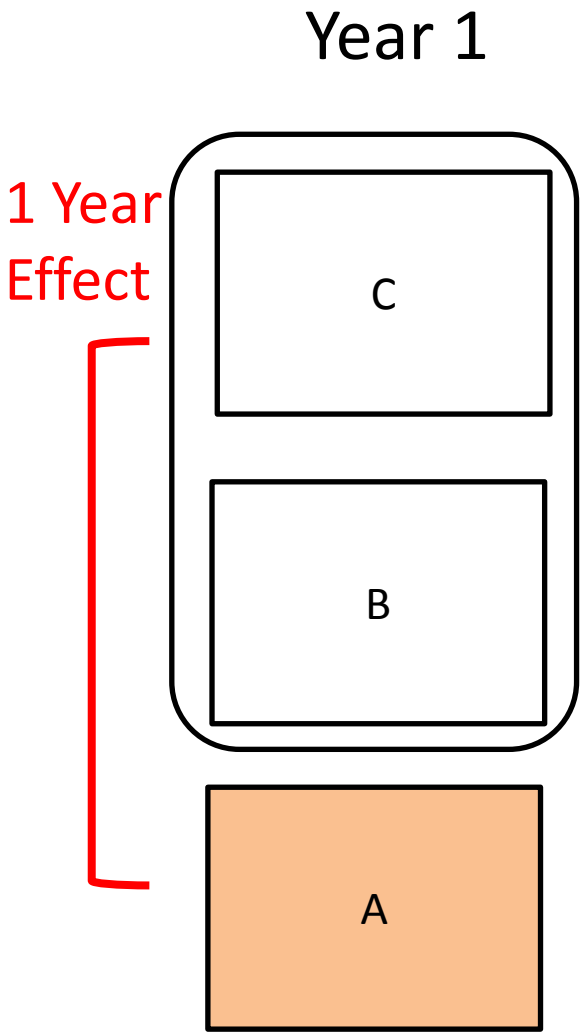
- When
  - Everyone given access eventually, but not at once
  - Average program impact during different periods

Phase-in

Year 1



Phase-in



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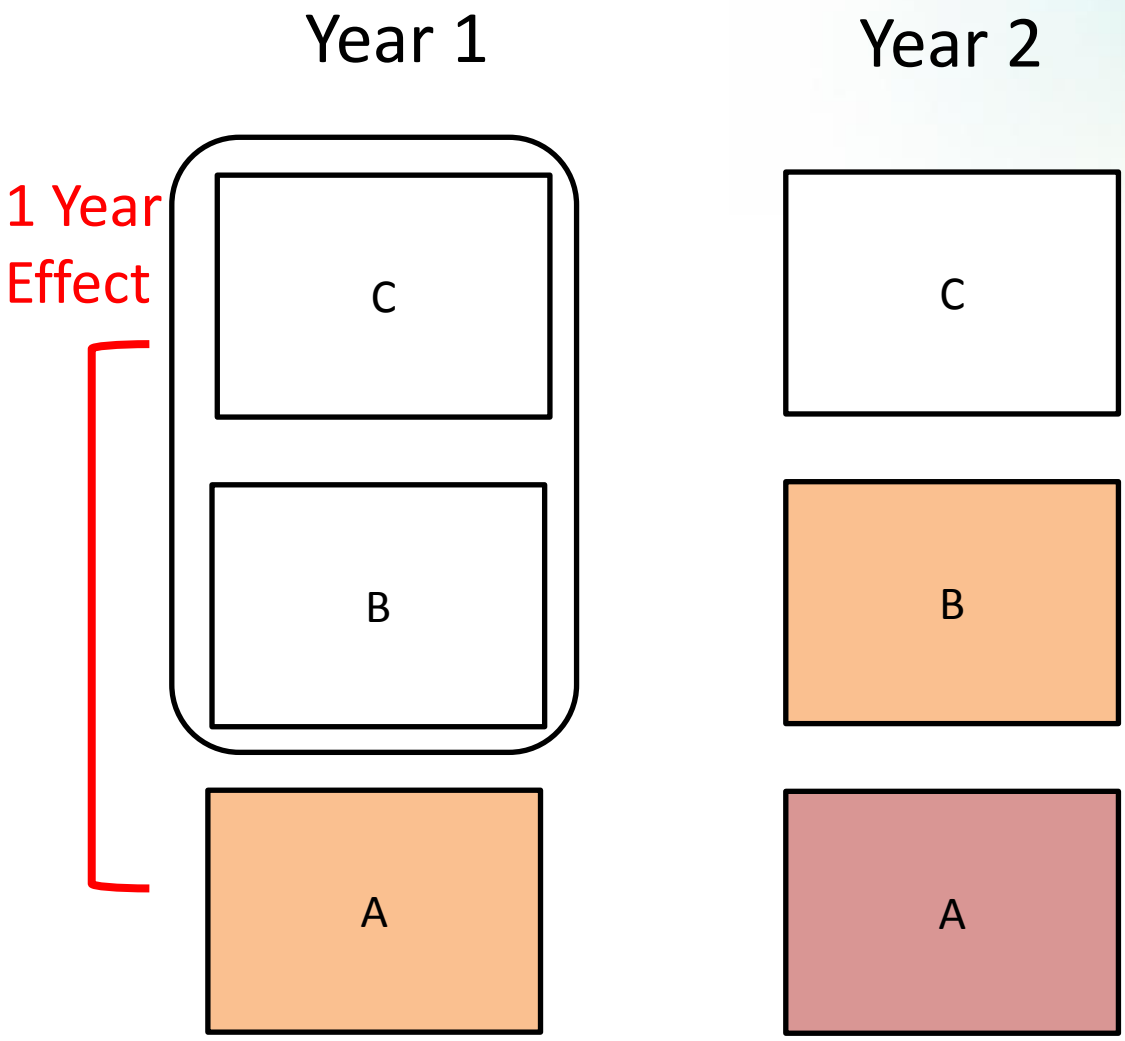

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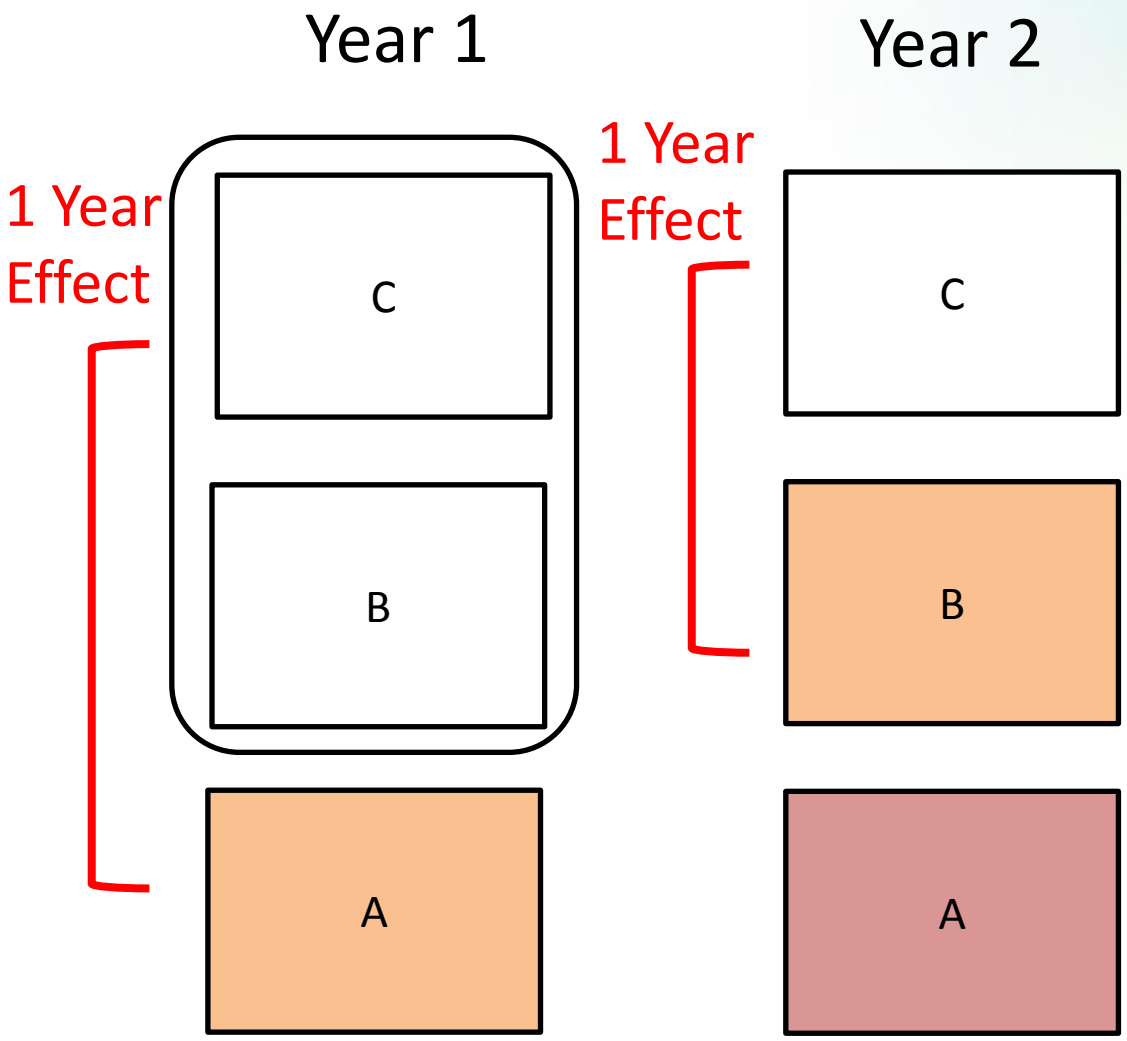

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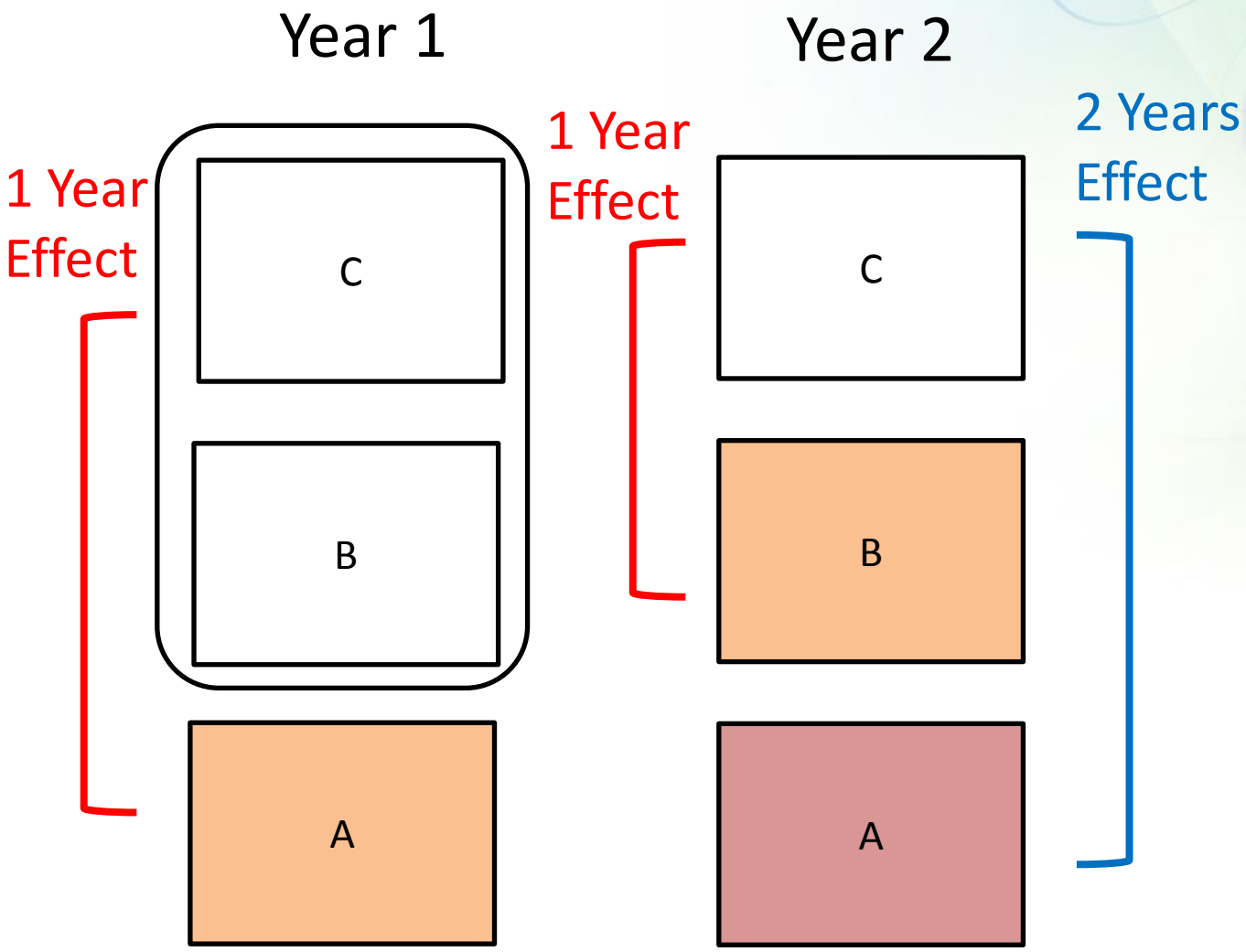
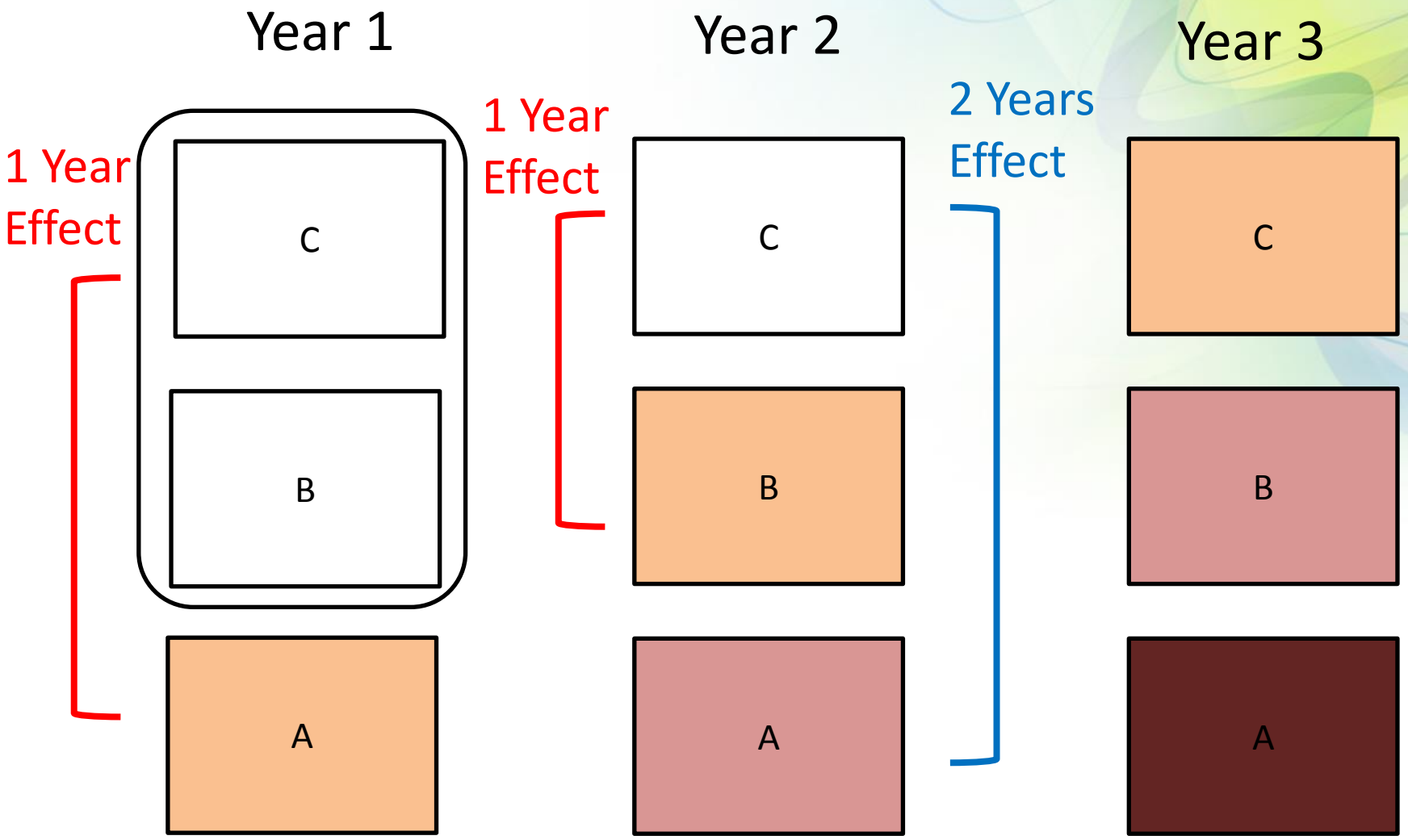

Year 1
Year 2
1 Year Effect
1 Year Effect
2 Years Effect
C
B
A
C
B
A

Phase-in


Year 1
Year 2
Year 3
1 Year Effect
1 Year Effect
2 Years Effect
C
B
A
C
B
A
C
B
A

Phase-in

- Notice
  - Anticipation of treatment
  - The time to effect should be shorter than treatment period

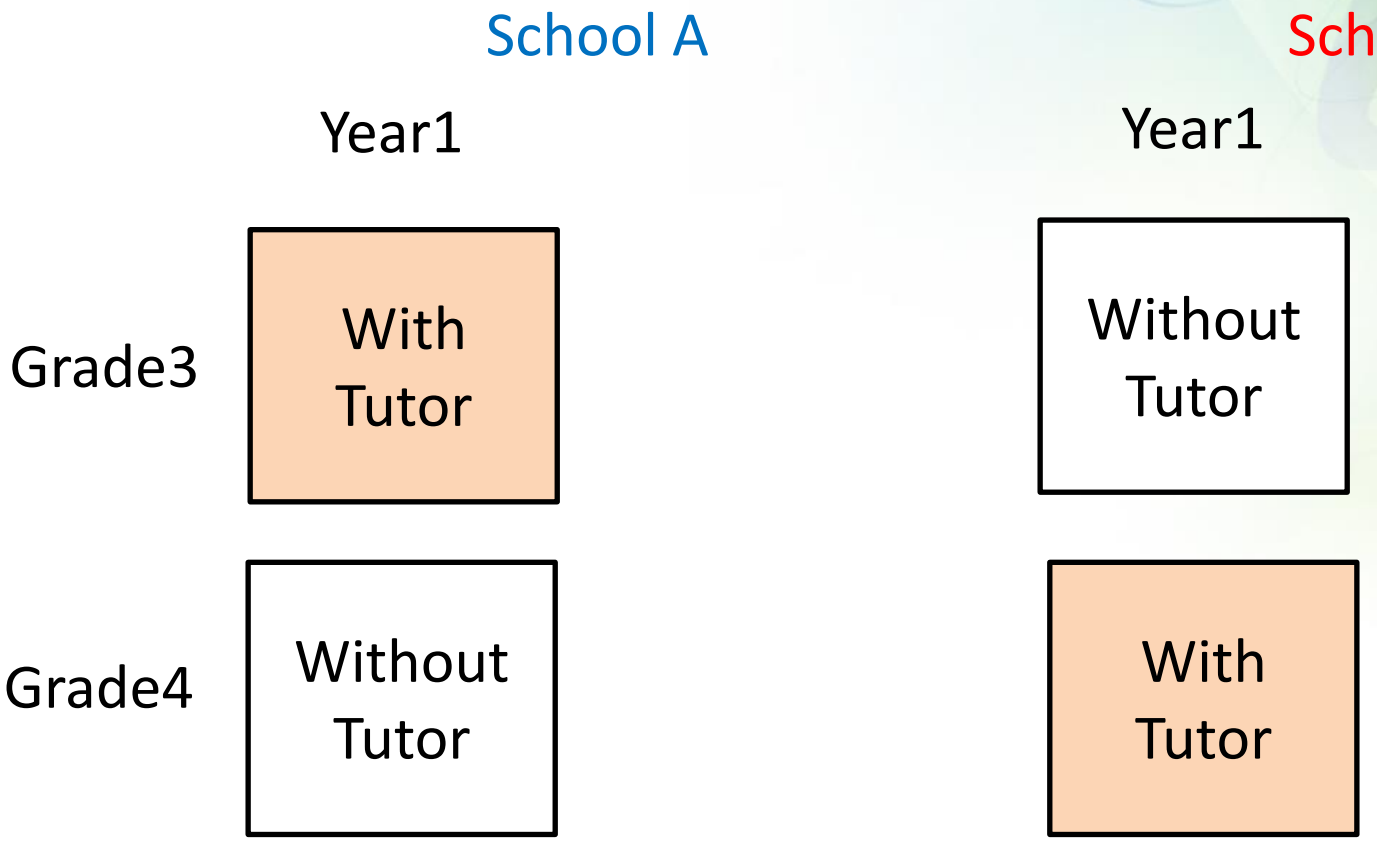
Rotation

- When
  - Limited resource everyone needs, not expected to increase
  - Effect only happens during the time of experiment

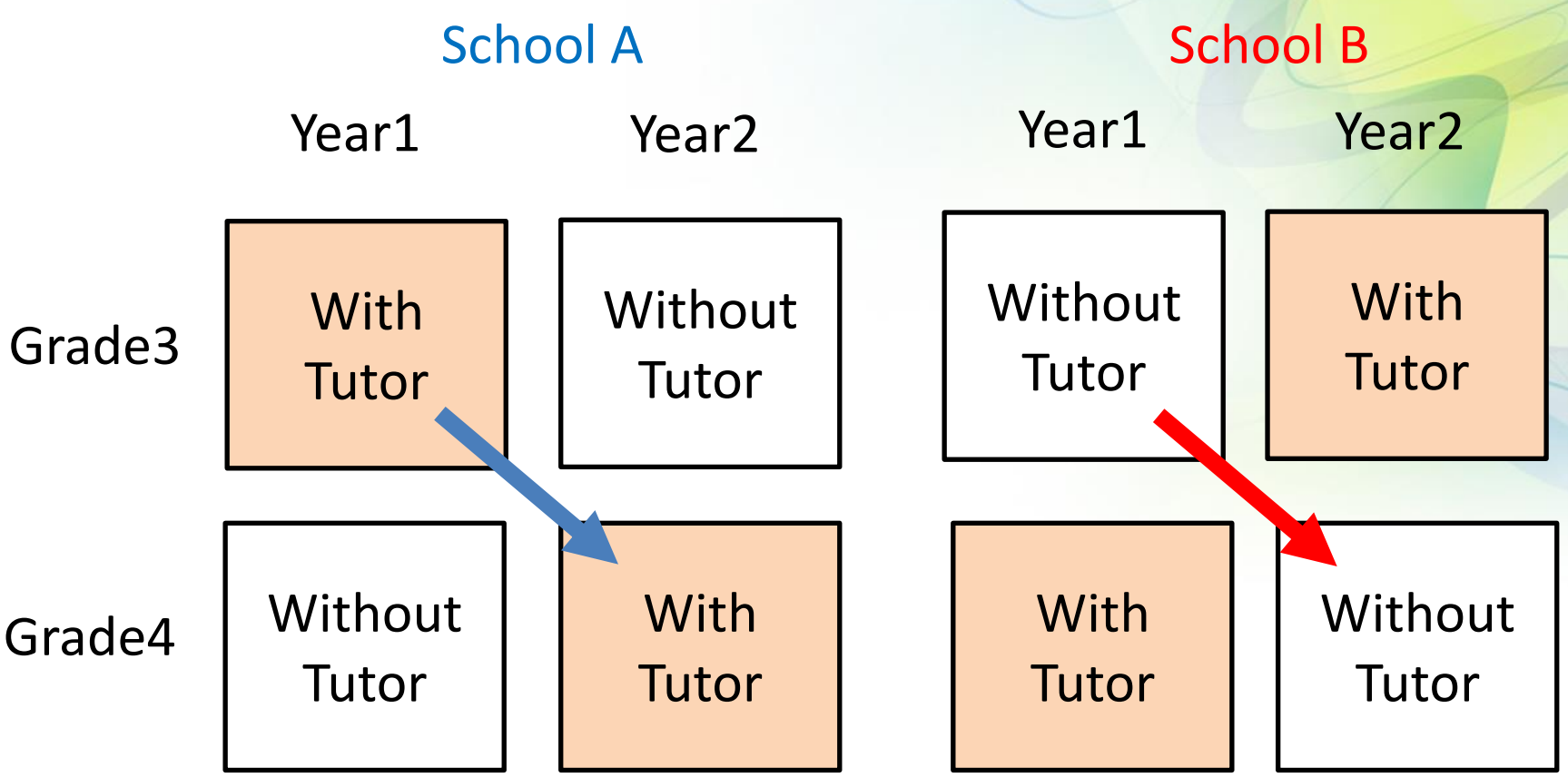
Rotation

- Notice
  - No pure comparison group in the long-run
  - Arrange order to measure effect of certain length
  - Anticipation of treatment
  - The time to effect
- E.g. Remedial education in India
  - Impact of tutor for 2 years

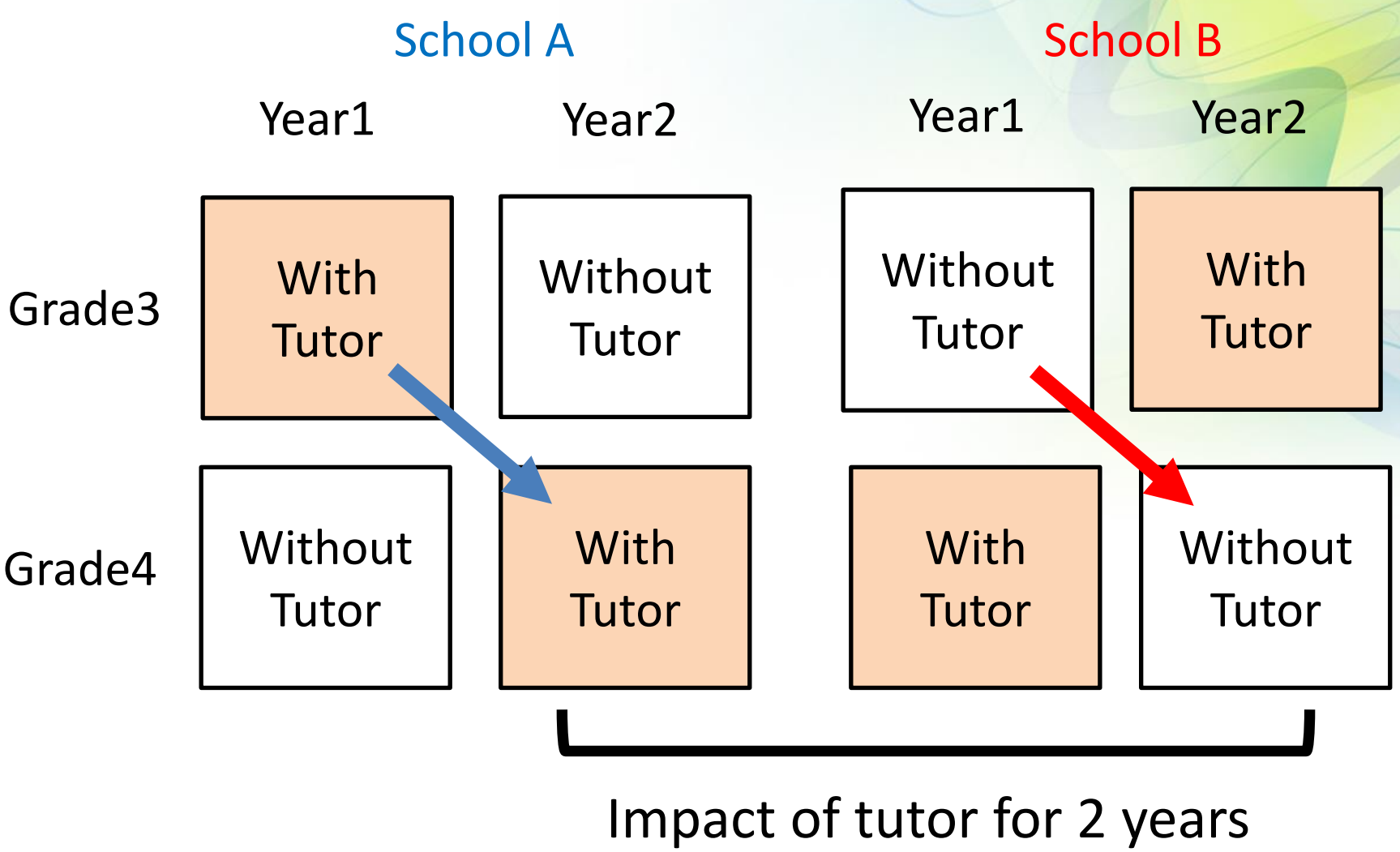
Remedial education in India



Remedial education in India



Remedial education in India



Encouragement

- When
  - Program open to all but under-subscribed
- Notice
  - Effect on “marginal person”
  - Not large enough to directly affect outcome
  - Not discourage others
- E.g. Retirement saving at American Univ.
  - Subsidy 20$ to people attending information fair

Conclusion

- What, when and how to do the randomization
- Simple, stratified and pairwise randomization
- Some common designs of randomization