Randomization Technical Appendix

This document provides a technical overview of how the RCE Coach Randomization tool functions. For a brief introduction to randomized pilots as a research design you can refer to our Randomization Overview.

Randomization attempts to create two groups that are as similar as possible in both observed and unobserved characteristics. You could flip a coin to assign students to either pilot the technology or not. This process implies that students have a 50% probability of piloting the technology regardless of any other characteristics. Therefore, if you have a group sufficiently large, the two groups should be the same in both observed and unobserved characteristics. You can think of the Coach as a way to flip a virtual coin many times, very quickly. Additionally, anyone can access to code to see that the coin is fair, and the probabilities can be different than 50% to allow a smaller, or larger, fraction of the population to initially test the technology.

WHAT DOES IT MEANS TO HAVE A SUCCESSFUL RANDOMIZATION?

A successful randomization process will produce a treatment and comparison group that are very similar. When you have a large number of observations, randomization is likely to succeed at creating two similar groups. For smaller samples, it is possible that the two groups are different in important ways even though a random process was used to create them. The Coach uses the baseline equivalence standard from the What Works Clearinghouse to assess whether the two groups are similar enough. We encourage you to use some pre-intervention measure that is related to the outcome to check for baseline balance, but this is not required. The Coach will consider that randomization worked as expected if the differences on all the variables selected to control for balance are less than 0.25 standard deviations. The Coach will assume that randomization worked as expected if no variables are specified to check for baseline equivalence.

HOW DOES THE TOOL WORK?

The RCE Coach uses R, a free software for statistical computing. In particular, the Coach uses the base R function "sample.int" to do the randomization. The Coach will first perform several checks on the data to confirm that there are no data issues that would cause an error with the randomization code. Then the Coach will randomly assign observations to the intervention or comparison group and if baseline variables were specified, will check that randomization worked as expected. The rest of this document describes the specific data checks and randomization algorithm.

Step 1: Check for data issues

The Coach will perform the following checks to verify that the Coach has the necessary inputs to perform the randomization:

1. Data is NULL, not readable, or has 0 observations.
2. Variable specifying the randomization unit ID is not specified or does not exist.
3. Whether groups should be determined by either a set 'number' or 'percentage' is not indicated

4. 'Percentage' was selected for assignment and the number of users indicated is less than or equal to 0 or greater than or equal to 100.
5. 'Number' was selected for assignment and the number of users indicated is less than or equal to 0 or greater than or equal to the number of records in the data.
6. Baseline variables are specified and not all exist in the data.
7. Baseline variables are specified and one or more are not numeric.
8. A variable named 'Treatment' already exists in the data.

If any test fails, the Coach will print a message to help the user identify the problem. If the Coach detects no problems, it will proceed to Step 2.

Step 2: Randomize and check for balance

The Coach will perform the randomization using a loop that stops either when randomization is successful or after 10 failed attempts. Randomization is deemed successful when all variables selected for the baseline equivalence checks are balanced across the two groups. If the randomization was successful, the user will be able to download the data and move to the next step in the Coach. Otherwise, the coach will randomize again with a new randomization seed. If the Coach fails to produce a successful randomization 10 times, it will inform the user that randomization did not work as expected. The following steps describe the loop:

1. The Coach randomly selects a randomization seed.
2. Using "sample.int" a number of observations is chosen to be in the treatment group. This is either a fixed proportion of the sample (rounded up to the nearest whole observation) or a fixed number of observations.
3. The Coach checks if randomization was successful.
4. If randomization is successful a file will be available to download with the original data plus one variable indicating if the observation belongs to the treatment or comparison group.
5. If the randomization is not successful
    a. If the loop has run fewer than 10 times, a new seed will be chosen and the loop will run again
    b. If the loop has run 10 times a message will explain to the user that the randomization was not successful.

The code for the RCE Coach is open-source under the GPL-V3 license and available on our github repository: https://github.com/mathematica-mpr/edtechrce