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Sample size calculation with clustered design

In the panchayat case, you were introduced to the concept of clustering. Your evaluation team was interested in measuring the effect of a *treatment* (reservations for women) on outcomes at the village and household level. However, the randomization of women council leaders was done at the Gram Panchayat level – it was done on a cluster of villages. It could be that the outcome of interest is correlated for villages that belong to the same Panchayat. For example, all the villages in a Panchayat will be subject to similar rainfall and other economic shocks. This means that when one village in the Panchayat does particularly well for this random reason (e.g. a good rainfall shock) all the villages in the same Panchayat will also do better.

This will lead to more noise, and hence larger standard error than in the usual case of independent sampling: in effect, we have less variation than we think. When planning both the sample size and the best way to sample villages and Panchayats, we need to take this into account.

This exercise will help you understand how to do that. Should you sample all the villages in a Gram Panchayat? Should you sample 1 village from 100 Gram Panchayats? Or should you sample 3 villages in 40 Panchayats? How do you decide?

We will work through these questions by determining the sample size that allows us to detect a specific effect with at least 80% power. Remember power is the likelihood that *when the treatment has an effect* you will be able to distinguish it from zero in your sample.

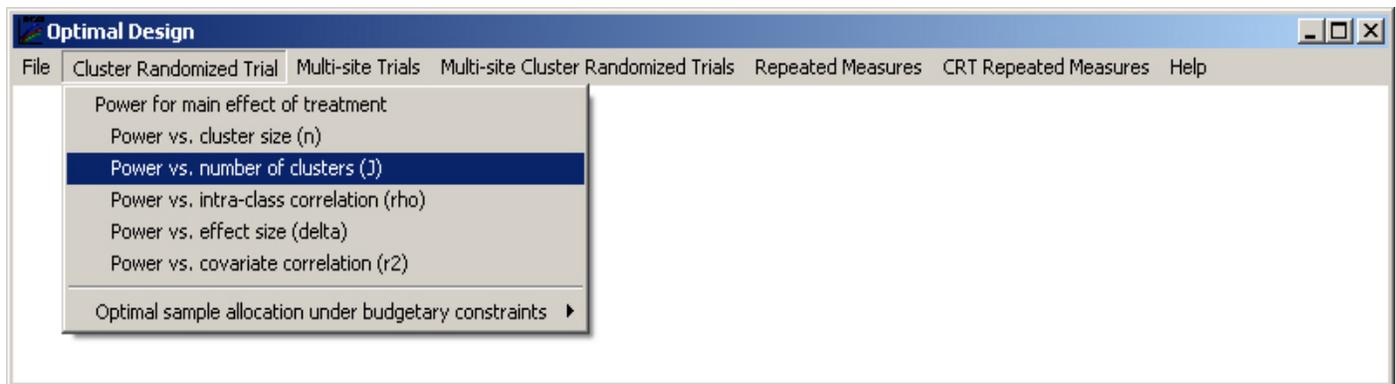
This exercise shows you how the power of your sample changes with the number of clusters, the size of the clusters, the size of the treatment effect and the Intraclass Correlation Coefficient. We will use a software program developed by Steve Raudebush with funding from the William T. Grant Foundation. You can find additional resources on clustered designs on their web site.

Section I: Using the OD Software

First download the OD software from the website (a software manual is also available):

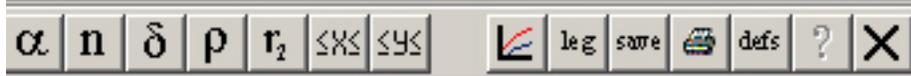
http://sitemaker.umich.edu/group-based/optimal_design_software

After you have downloaded it, open the executable and you will see a screen which looks like the one below. Select the menu option: Cluster Randomized Trial.



Under the Cluster Randomized Trial menu you will see several options to generate graphs.

Select the Power vs. number of clusters (J) option. Another menu pops up:

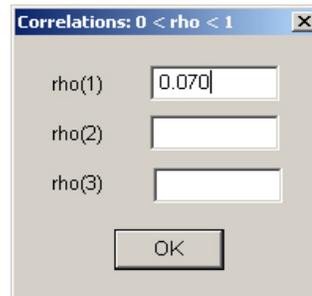
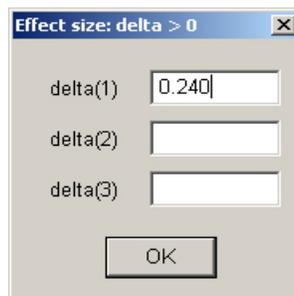
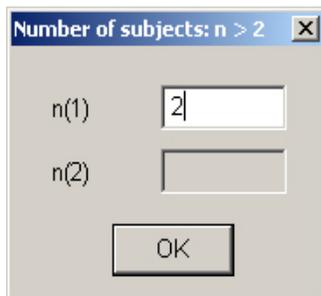


Select α (alpha). You'll see it is already set to .050 for a 95% significance level.

Next click on **n**, the number of villages per cluster. Suppose you are interested in knowing what kind of power you can get if you sample 2 villages from each Gram Panchayat. Fill in n(1) with 2 and click OK.

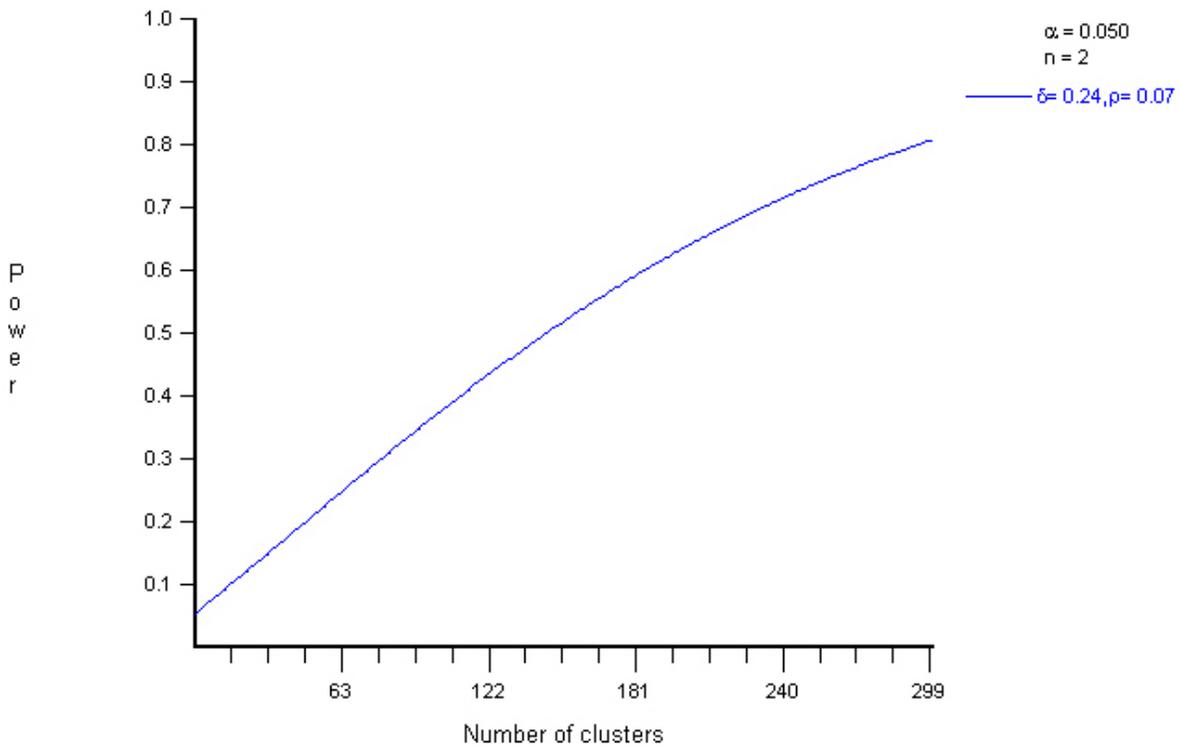
Now we have to determine δ (delta), the *standardized effect size* (the effect size divided by the standard deviation of the variable of interest). Assume you are interested in detecting whether there is an increase of 30% in the investment in drinking water undertaken in Gram Panchayats reserved for women over two years. In a small pilot survey, you determined that, in Panchayats that are not reserved, there are on average 15 instances of investment in the past two years, and that the standard deviation of the number of investments is 19. We want to detect an effect size of 30% of 15, which is 4.5. We then divide this by the standard deviation to get δ equal to 4.5/19 or 0.24.

Select δ from the menu. In the dialogue box that appears there is a prefilled value of 0.200 for delta(1). Change the value to 0.24, and change the value of delta (2) to empty. Select OK.

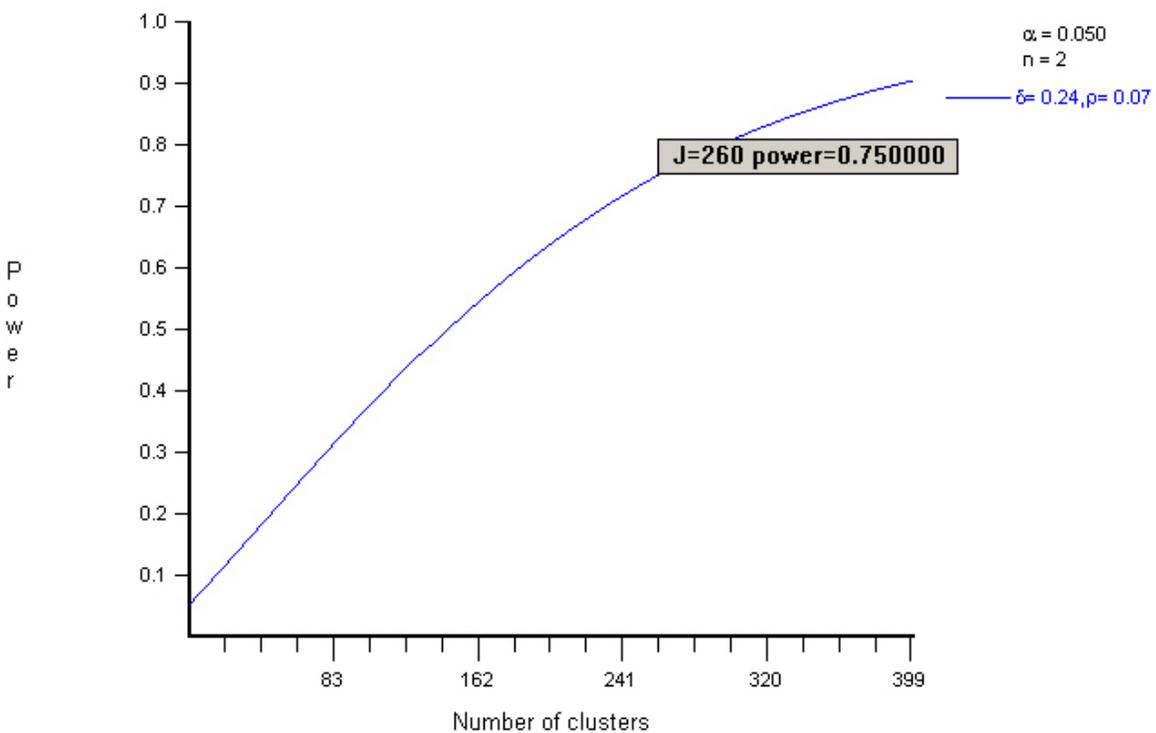


Finally we need to choose ρ , which is the *intra-cluster correlation*. ρ tells us how strongly the outcomes are correlated for units within the same cluster. If the villages within a Gram Panchayat are in fact independent with respect to the variable of interest, in this case drinking water, then ρ will equal 0. If on the other hand the villages in the Gram Panchayat were identical (no variation) with respect to drinking water outcomes, then ρ would equal 1. You have determined in your pilot study that ρ is 0.07. Fill in rho(1) to 0.07, and set rho (2) to be empty.

You should see a graph similar to the one below. How does the number of clusters change the power of the sample? How many clusters do you need to sample to get 80% power?



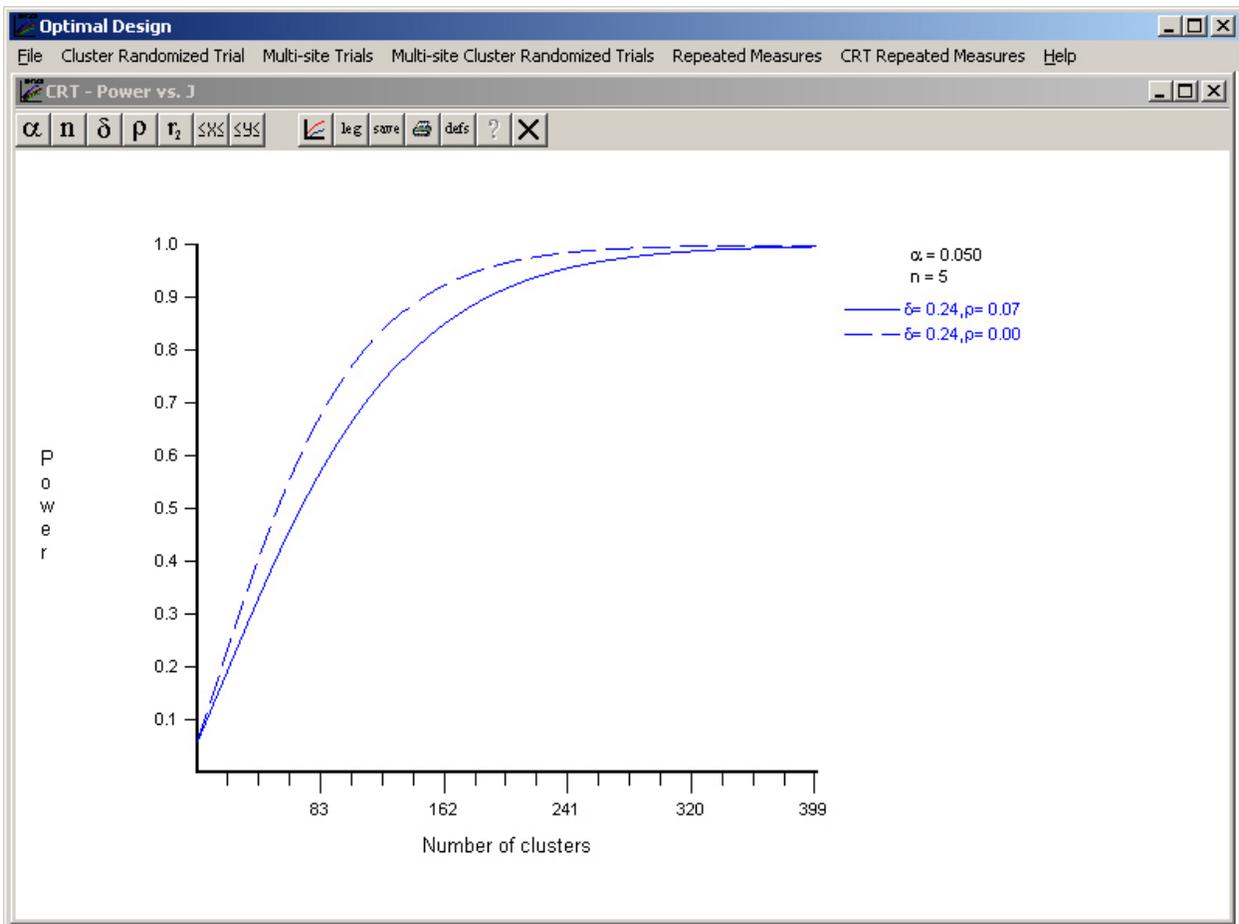
You can click on the graph with your mouse to see the exact power and number of clusters for a particular point:



You have seen how many clusters you need for 80% power, sampling two villages per Panchayat. Now suppose you are interested in sampling 5 villages from each Gram Panchayat. Change n to 5. What does the new graph look? What is the new number of clusters you need for 80% power?

Finally, let's see how the Intraclass Correlation Coefficient (ρ) changes power of a given sample. Leave $\rho(1)$ to be 0.07 but for comparison change $\rho(2)$ to 0.00.

You should see a graph like the one below. The solid blue curve is the one with the parameters you've set - based on your pretesting estimates of the effect of reservations for women on drinking water. The blue dashed curve is there for comparison - to see how much power you would get from your sample if ρ were zero. Look carefully at the graph. How does the power of the sample change with the Intraclass Correlation Coefficient (ρ)?

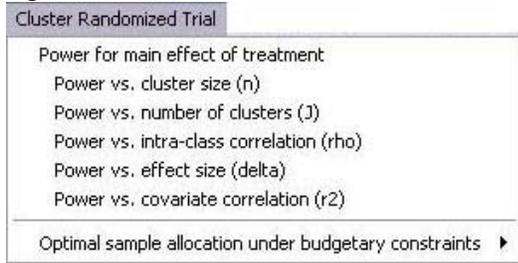


You can rescale the x and y axis using the menu options:



Other Cluster Randomized Trial Menu Options

To take a look at some of the other menu options, close the graph by clicking on the  in the top right hand corner of the inner window. Select the Cluster Randomized Trial menu again.



Try generating graphs for how power changes with cluster size (n), intra-class correlation (rho) and effect size (delta) . You will have to re-enter your pre-test parameters each time you open a new graph.

Section II: Working Within a Budget

Now that you have some familiarity with the parameters that determine power in clustered randomization, you need to incorporate your budget constraints. See the associated Excel exercise.

The Excel exercise is available online at:

http://povertyactionlab.org/course/cambridge_2007/ex.php

