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| Exercise: How to do Power Calculations in Optimal Design Software |

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# Introduction

This exercise will help explain the tradeoffs to power when designing a cluster randomized trail versus a design that uses individual-level randomization. Should we sample every student in just a few schools? Should we sample a few students from many schools? How do we 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.

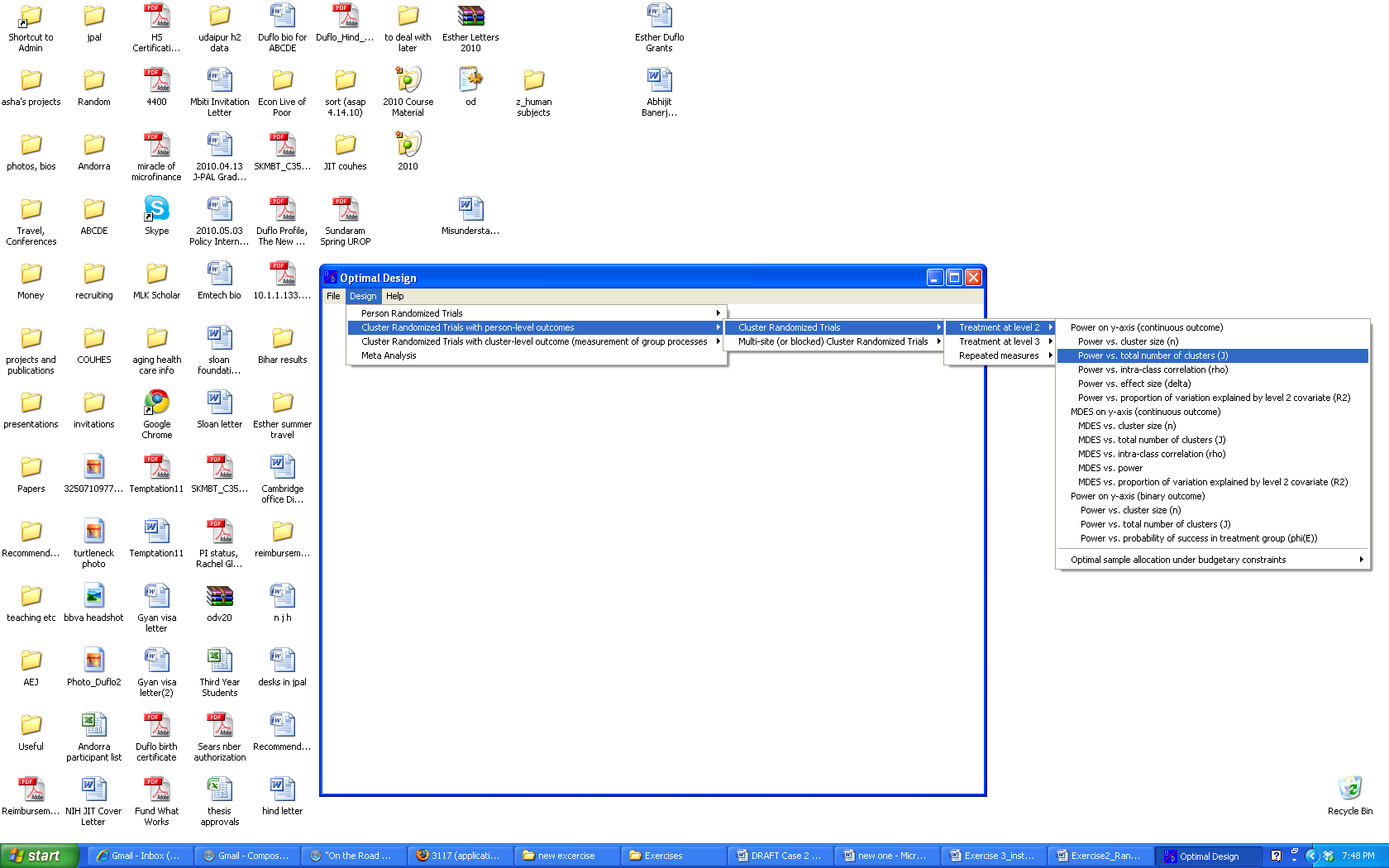
In this example, “clusters” refer to “clusters of children”—in other words, “classrooms” or “schools”. This exercise will demonstrate how the power of our sample changes with the number of clusters, the size of the clusters, the size of the treatment effect and the Intraclass Correlation Coefficient (rho, or **). We will use a software program developed by Steve Raudebush with funding from the William T. Grant Foundation. Additional resources on clustered designs can be found on their web site.

# Using the OD Software

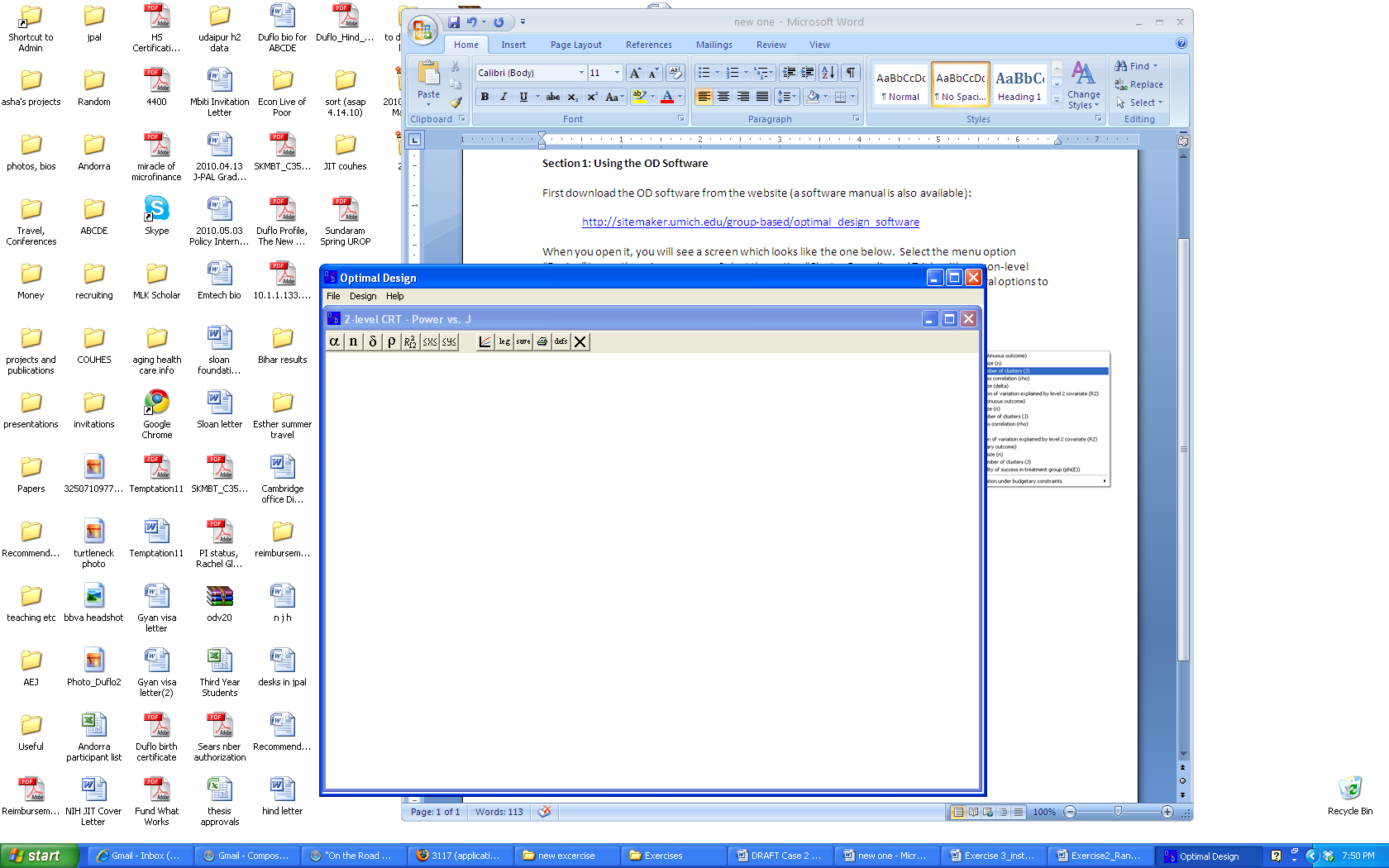
First download the OD software from the website (a software manual is also available):

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

When you open it, you will see a screen which looks like the one below. Select the menu option “Design” to see the primary menu. Select the option “Cluster Randomized Trials with person-level outcomes,” “Cluster Randomized Trials,” and then “Treatment at level 2.” You’ll see several options to generate graphs; choose “Power vs. Total number of clusters (J).”



A new window will appear:



Select **α** (alpha). You’ll see it is already set to 0.050 for a 95% significance level.

First let’s assume we want to test only 40 students per school. How many schools do you need to go to in order to have a statistically significant answer?

Click on **n**, which represents the number of students per school. Since we are testing only 40 students per school, so fill in n(1) with 40 and click OK.

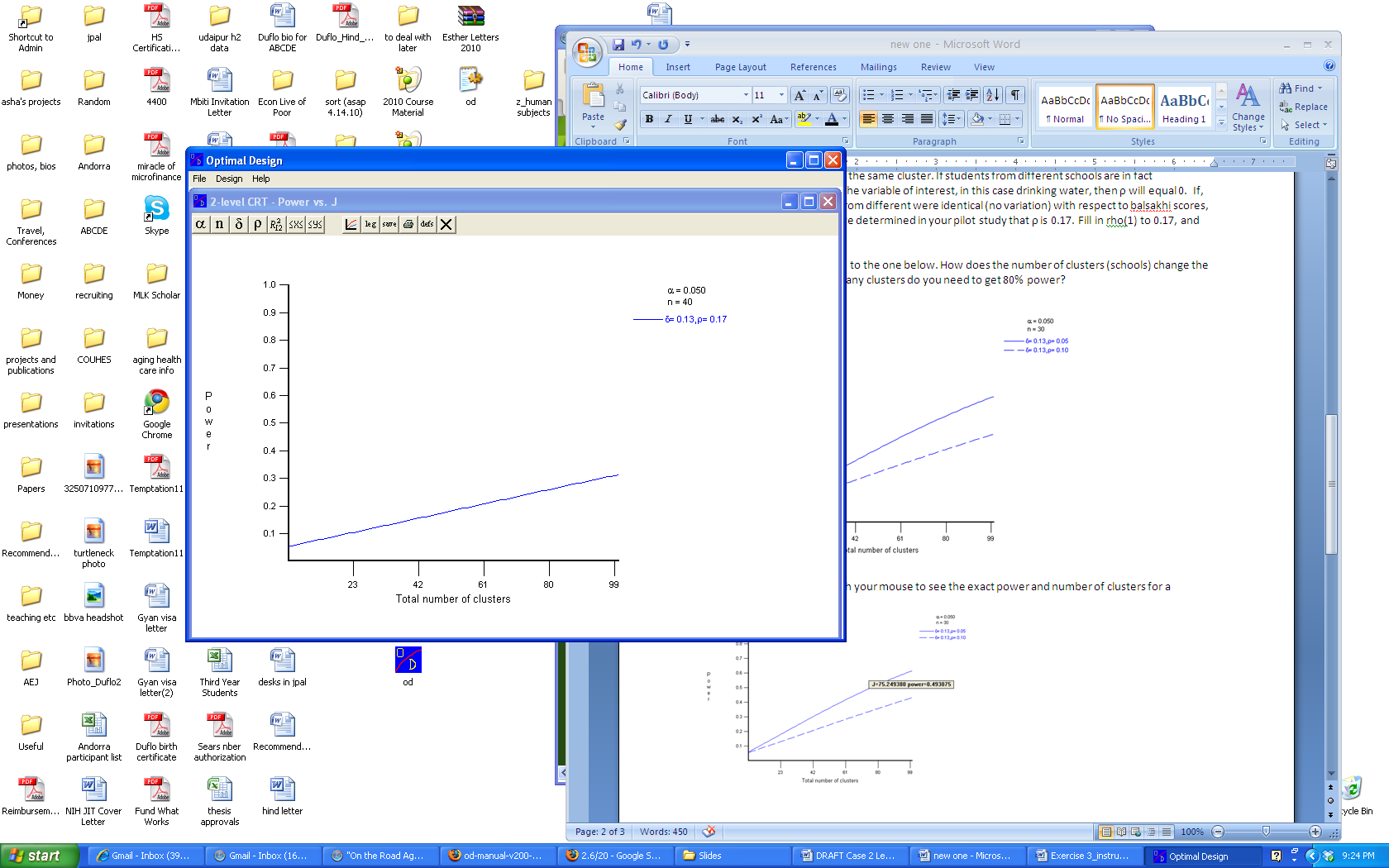
Now we have to determine δ (delta), the standard effect size (the effect size divided by the standard deviation of the variable of interest). Assume we are interested in detecting whether there is an increase of 10% in test scores. (Or more accurately, are uninterested in a detect less than 10%) Our baseline survey indicated that the average test score is 26, with a standard deviation of 20. We want to detect an effect size of 10% of 26, which is 2.6. We divide 2.6 by the standard deviation to get δ equal to 2.6/20, or 0.13.

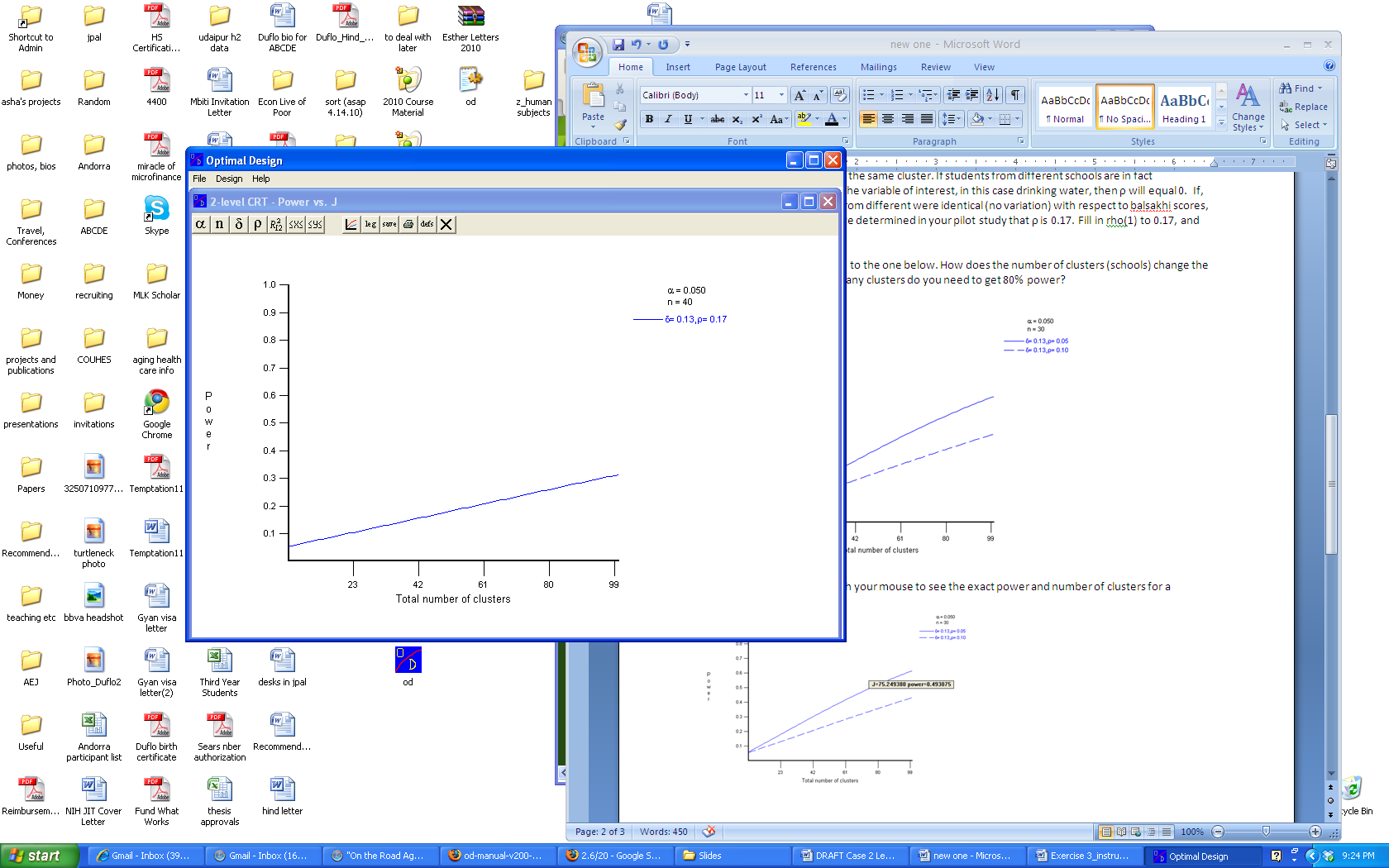
Select δ from the menu. In the dialogue box that appears there is a prefilled value of 0.200 for delta(1). Change the value to 0.13, and change the value of delta (2) to empty. Select OK.

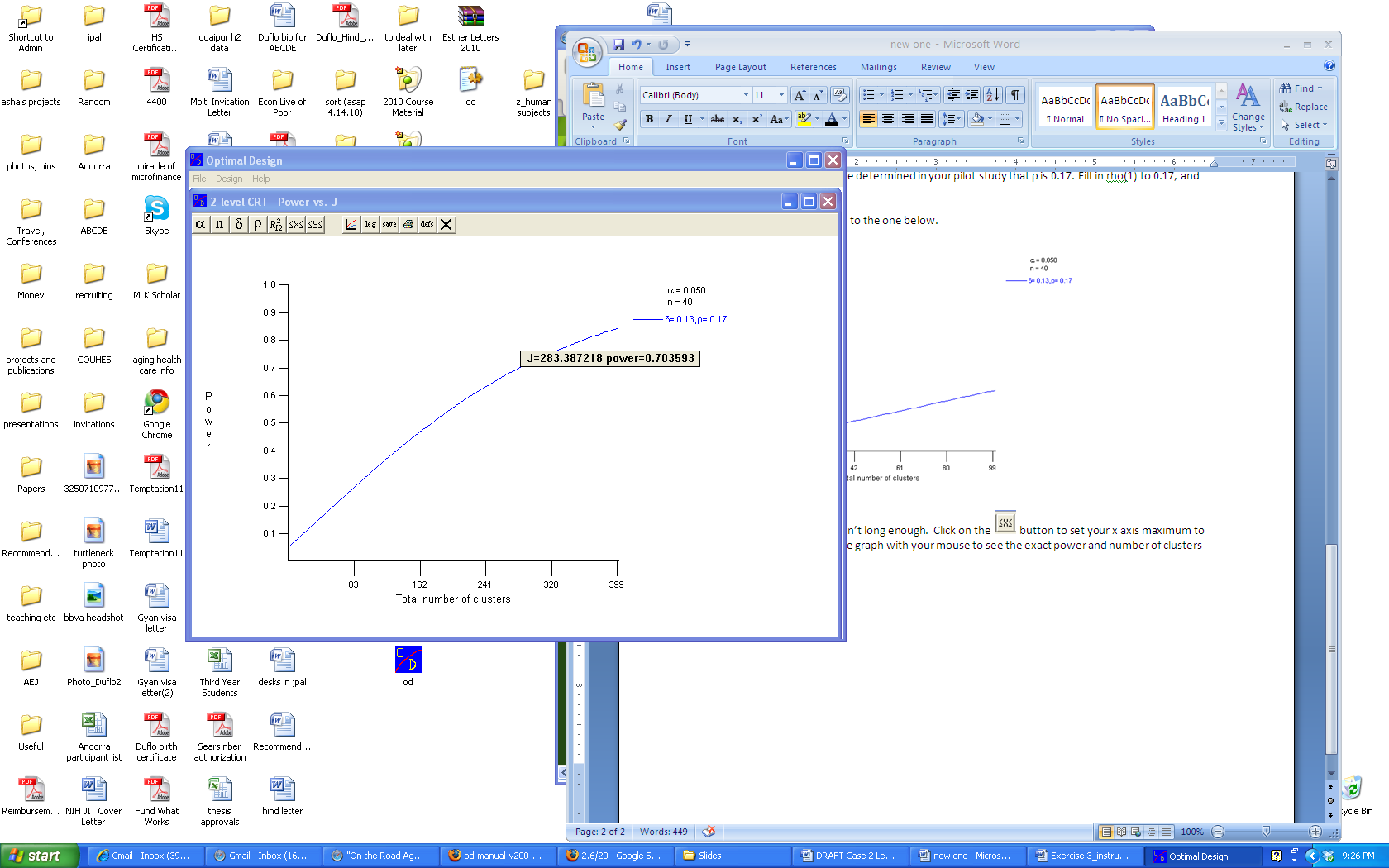
Finally we need to choose ***ρ*** (rho), which is the intra-cluster correlation. ***ρ*** tells us how strongly the outcomes are correlated for units within the same cluster. If students from the same school were clones (no variation) and all scored the same on the test, then ρ would equal 1. If, on the other hand, students from the same schools are in fact independent—and there was no differences between schools, then ***ρ*** will equal 0.

You have determined in your pilot study that ρ is 0.17. Fill in rho(1) to 0.17, and set rho (2) to be empty.

You should see a graph similar to the one below.



You’ll notice that your x axis isn’t long enough to allow you to see what number of clusters would give you 80% power. Click on the  button to set your x axis maximum to 400. Then, you can click on the graph with your mouse to see the exact power and number of clusters for a particular point.



Exercise 1:

1. How many schools are needed to achieve 80% power? 90% power?

Now you have seen how many clusters you need for 80% power, sampling 40 students per school. Suppose instead that you only have the ability to go to 124 schools (this is the actual number that was sampled in the Balsakhi program).

Exercise 2:

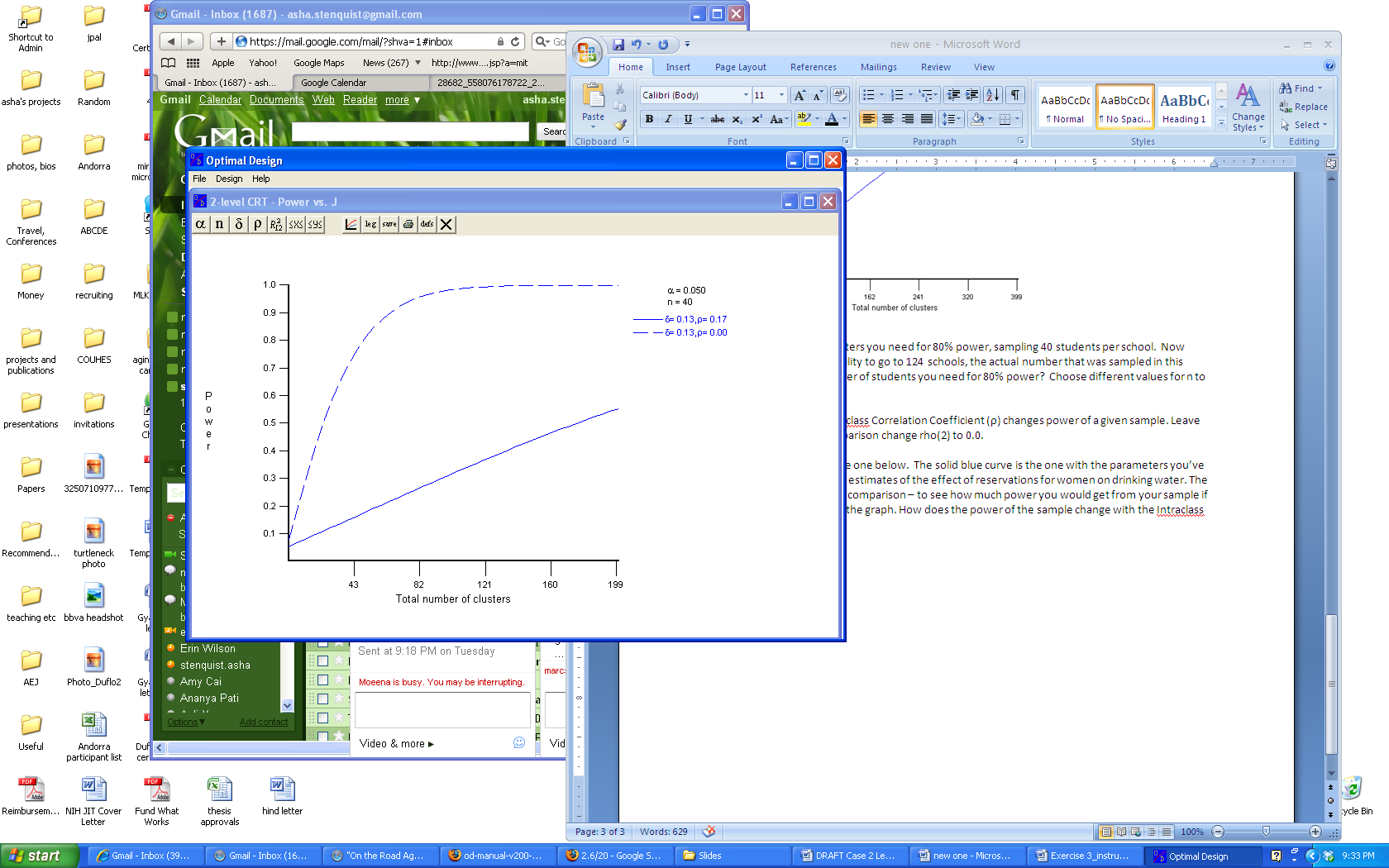
1. How many children per school are needed to achieve 80% power? 90% power?
2. Choose different values for n to see how your graph changes.

Finally, let’s see how the Intraclass Correlation Coefficient (ρ) changes power of a given sample. Leave rho(1) to be 0.17 but for comparison change rho(2) to 0.0.

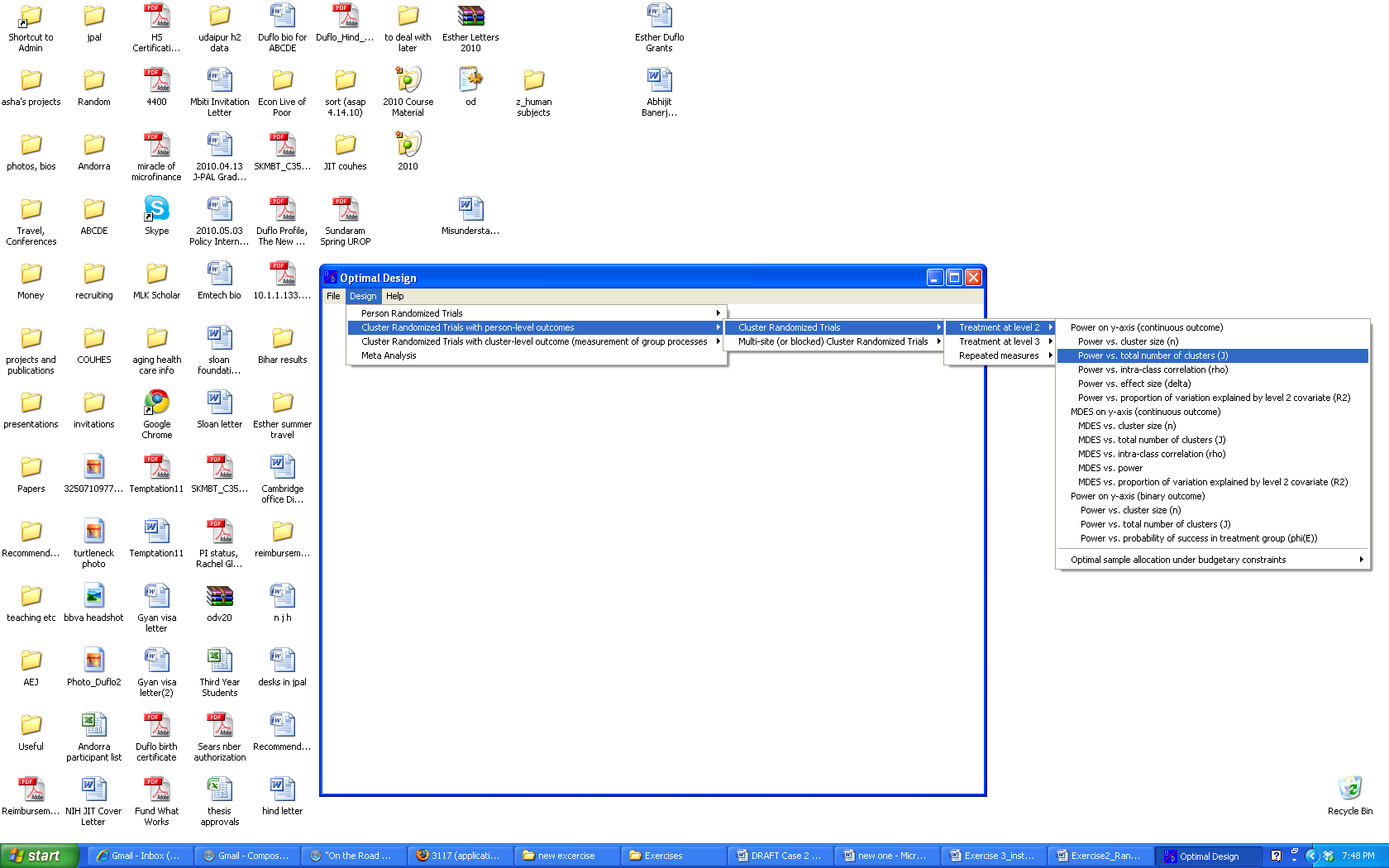
You should see a graph like the one below. The solid blue curve is the one with the parameters you’ve set - based on your pretesting estimates of the effect of reservations for women on drinking water. The blue dashed curve is there for comparison – to see how much power you would get from your sample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

Exercise 3:

1. How does the power of the sample change with the Intraclass Correlation Coefficient (ρ)?



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.



Exercise 4:

1. 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.