Power Analysis

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# Notes

As of Feb 18, 2021, I have only run models assuming between-cluster variance of about 10%. I am guessing that this is a high estimate. Also, I have assumed that we will have all 300 participants in both arms with the outcome variable not missing. Future analyses should consider other estimates of between-cluster variance and should evaluate the potential impact of attrition.

# Prepare workspace

Load the required packages.

require( clusterPower )  
require( longpower )

# GEE Model

## GEE Model Assuming OR=0.50

Estimate power for rejecting the null hypothesis that difference in the odds of non-abstinence (0=abstinent; 1=used drugs) across the reSET-O and treatment as usual care (TAU) conditions is 0 at weeks 9-12 of the study. The model assumes the following:

* Random allocation of half the total cluster (k=6) to reSET-O and half (k=6) to TAU
* Equal cluster sizes of 50 patients (300 patients in each group)
* Probability of non-abstinence in TAU assumed to be 40% based on [Maricich et al., 2020](https://www.tandfonline.com/doi/full/10.1080/03007995.2020.1846022)
* Probability of non-abstinence in reSET-O assumed to be 25% based on [Maricich et al., 2020](https://www.tandfonline.com/doi/full/10.1080/03007995.2020.1846022)
* This comes to an assumed odds ratio (OR) = 0.5, a 50% reduction in odds.

# geesim1 <- cps.binary( nsim = 1000,  
# nsubjects = 50, # 50 participants per cluster assuming equal sizes  
# nclusters = 6, # 6 clusters per treatment arm  
# p1=.40, # 40% non-abstinence rate in TAU in Maricich et al. (2020)  
# p2=.25, # 25% non-abstinence rate in reSET-0 group in Maricich et al. (2020)  
# sigma\_b\_sq=0.024, # variance = p(1-p)=0.24; assume 10% variance is between)  
# sigma\_b\_sq2=0.019, # variance = p(1-p)=0.1875; assume 10% variance is between)  
# alpha=.05,  
# method='gee',  
# quiet=F,  
# seed=0218211,  
# lowPowerOverride = TRUE)  
load( 'geesim1.RData' )  
summary( geesim1 )

##   
## Monte Carlo Power Estimation based on 1000 Simulations: Simple Design, Binary Outcome. Note: 0 additional models were fitted to account for non-convergent simulations.  
##   
## Power Estimate (alpha = 0.05):  
## Power Lower.95.CI Upper.95.CI Alpha Beta Converged Requested  
## 0.956 0.9413796 0.9678505 0.05 0.044 1000 1000  
##   
## Method: Generalized Estimating Equation   
##   
## Variance Parameters:  
## sigma\_b\_sq  
## Arm1 0.024  
## Arm2 0.019  
##   
## Clusters:  
## n.clust  
## Arm1 6  
## Arm2 6  
##   
## Observations:  
## $Arm1  
## [1] 50 50 50 50 50 50  
##   
## $Arm2  
## [1] 50 50 50 50 50 50  
##   
##   
## Convergence:  
## TRUE   
## 1000

This simulation suggests that our power would be between 0.94-0.97 – i.e., well powered.

## GEE Model Assuming OR=0.80

Now we will calculate power using a simulation assuming a more modest effect where reSET-O results in a 20% reduction in the odds.

* Assume a 40% non-abstinence rate in TAU
* Assume a 35% non-abstinence rate in reSET-O
* Keep all of the rest of the assumptions the same as in the previous simulation

# geesim2 <- cps.binary( nsim = 1000,  
# nsubjects = 50, # 50 participants per cluster assuming equal sizes  
# nclusters = 6, # 6 clusters per treatment arm  
# p1=.40, # 40% non-abstinence rate in TAU in Maricich et al. (2020)  
# p2=.35, # 25% non-abstinence rate in reSET-0 group in Maricich et al. (2020)  
# sigma\_b\_sq=0.024, # variance = p(1-p)=0.24; assume 10% variance is between)  
# sigma\_b\_sq2=0.023, # variance = p(1-p)=0.2275; assume 10% variance is between)  
# alpha=.05,  
# method='gee',  
# quiet=F,  
# seed=0218211,  
# lowPowerOverride = TRUE )  
load( 'geesim2.RData' )  
summary( geesim2 )

##   
## Monte Carlo Power Estimation based on 1000 Simulations: Simple Design, Binary Outcome. Note: 0 additional models were fitted to account for non-convergent simulations.  
##   
## Power Estimate (alpha = 0.05):  
## Power Lower.95.CI Upper.95.CI Alpha Beta Converged Requested  
## 0.263 0.2359435 0.2914594 0.05 0.737 1000 1000  
##   
## Method: Generalized Estimating Equation   
##   
## Variance Parameters:  
## sigma\_b\_sq  
## Arm1 0.024  
## Arm2 0.023  
##   
## Clusters:  
## n.clust  
## Arm1 6  
## Arm2 6  
##   
## Observations:  
## $Arm1  
## [1] 50 50 50 50 50 50  
##   
## $Arm2  
## [1] 50 50 50 50 50 50  
##   
##   
## Convergence:  
## TRUE   
## 1000

This simulation suggests that our power would be between 0.23-0.29 – i.e., poorly powered.

## GEE Model Assuming OR=0.65

Now we will calculate power using a simulation assuming an in-between effect where reSET-O results in a ~35% reduction in the odds.

* Assume a 40% non-abstinence rate in TAU
* Assume a 30% non-abstinence rate in reSET-O
* Keep all of the rest of the assumptions the same as in the previous simulation

# geesim3 <- cps.binary( nsim = 1000,  
# nsubjects = 50, # 50 participants per cluster assuming equal sizes  
# nclusters = 6, # 6 clusters per treatment arm  
# p1=.40, # 40% non-abstinence rate in TAU in Maricich et al. (2020)  
# p2=.30, # 25% non-abstinence rate in reSET-0 group in Maricich et al. (2020)  
# sigma\_b\_sq=0.024, # variance = p(1-p)=0.24; assume 10% variance is between)  
# sigma\_b\_sq2=0.021, # variance = p(1-p)=0.21; assume 10% variance is between)  
# alpha=.05,  
# method='gee',  
# quiet=F,  
# seed=0218211,  
# lowPowerOverride = TRUE )  
load( 'geesim3.RData' )  
summary( geesim3 )

##   
## Monte Carlo Power Estimation based on 1000 Simulations: Simple Design, Binary Outcome. Note: 0 additional models were fitted to account for non-convergent simulations.  
##   
## Power Estimate (alpha = 0.05):  
## Power Lower.95.CI Upper.95.CI Alpha Beta Converged Requested  
## 0.688 0.6582616 0.7166268 0.05 0.312 1000 1000  
##   
## Method: Generalized Estimating Equation   
##   
## Variance Parameters:  
## sigma\_b\_sq  
## Arm1 0.024  
## Arm2 0.021  
##   
## Clusters:  
## n.clust  
## Arm1 6  
## Arm2 6  
##   
## Observations:  
## $Arm1  
## [1] 50 50 50 50 50 50  
##   
## $Arm2  
## [1] 50 50 50 50 50 50  
##   
##   
## Convergence:  
## TRUE   
## 1000

This simulation suggests that our power would be between 0.66-0.71 – i.e., moderately powered.

## GEE Model Assuming OR=0.60

# geesim4 <- cps.binary( nsim = 1000,  
# nsubjects = 50, # 50 participants per cluster assuming equal sizes  
# nclusters = 6, # 6 clusters per treatment arm  
# p1=.40, # 40% non-abstinence rate in TAU in Maricich et al. (2020)  
# p2=.29, # 25% non-abstinence rate in reSET-0 group in Maricich et al. (2020)  
# sigma\_b\_sq=0.024, # variance = p(1-p)=0.24; assume 10% variance is between)  
# sigma\_b\_sq2=0.021, # variance = p(1-p)=0.21; assume 10% variance is between)  
# alpha=.05,  
# method='gee',  
# quiet=F,  
# seed=0218211,  
# lowPowerOverride = TRUE )  
load( 'geesim4.RData' )  
summary( geesim4 )

##   
## Monte Carlo Power Estimation based on 1000 Simulations: Simple Design, Binary Outcome. Note: 0 additional models were fitted to account for non-convergent simulations.  
##   
## Power Estimate (alpha = 0.05):  
## Power Lower.95.CI Upper.95.CI Alpha Beta Converged Requested  
## 0.763 0.7353915 0.7890505 0.05 0.237 1000 1000  
##   
## Method: Generalized Estimating Equation   
##   
## Variance Parameters:  
## sigma\_b\_sq  
## Arm1 0.024  
## Arm2 0.021  
##   
## Clusters:  
## n.clust  
## Arm1 6  
## Arm2 6  
##   
## Observations:  
## $Arm1  
## [1] 50 50 50 50 50 50  
##   
## $Arm2  
## [1] 50 50 50 50 50 50  
##   
##   
## Convergence:  
## TRUE   
## 1000

This simulation suggests that our power would be between 0.74-0.79 – i.e., approaching the goal of 0.80.

# Cox Propotional Hazards Model