

20201005-p8133_probset2_jsg2145

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Problem 2

Part a

```
14*pbinom(1, 14, .05) + 34*(1-pbinom(1, 14, .05))
```

```
## [1] 17.05971
```

The expected value of the sample size is $17.05 \sim 18$.

Part b

Go means that there was at least one response in the futility trial and 4 responses in the go-no-go trial.

```
gonogo = function(stage1, stage2, null, alt, n1, n2) {  
  res = vector(mode = "list", length = stage1)  
  for(i in 1:stage1) {  
    for(j in 1:stage2){  
      res[[c(i,j)]] = bind_cols("n1_response" = i, "n2_response" = j-i)  
    }  
    res[[i]] = map(res[[i]], ~bind_rows(.))  
  }  
  
  sum_df = bind_rows(res) %>%  
    mutate(errorI = dbinom(n1_response, stage1, null) * dbinom(n2_response, stage2, null),  
           power = dbinom(n1_response, stage1, alt) * dbinom(n2_response, stage2, alt)) %>%  
    filter(n1_response > n1-1,  
           n1_response + n2_response > n2-1) %>%  
    summarize(sum_error = sum(errorI),  
              sum_power = sum(power))  
  
  return(sum_df)  
}
```

```
sum_df = gonogo(stage1 = 14, stage2 = 20, null = .05, alt = 0.2, n1 = 1, n2 = 4)
```

The probability of rejecting the null given that the null is true is 0.0804.

Part c

The probability of rejecting the null given that the alternative is true is 0.9041.

Part d

type I error = .0804, power = 0.9041

null = 5%, alternative = 20%

n =

$$\frac{2(z_{\alpha} + z_{1-\beta})^2(\sigma^2)}{\Delta^2}$$

```
fixed = function(maxn, null, alt, error_prev, power_prev) {
  errorI = vector(mode = "list", length = maxn)
  power = vector(mode = "list", length = maxn)
  res = vector(mode = "list", length = maxn)
  for(i in 1:maxn) {
    for(j in 1:i) {
      errorI[[c(i, j)]] = 1 - pbinom(j-1, i, null)
      power[[c(i, j)]] = 1 - pbinom(j-1, i, alt)
      res[[c(i, j)]] = bind_cols("i" = i, "j" = j, "errorI" = errorI[[c(i, j)]] , "power" = power[[c(i, j)]] )
    }
    res[[i]] = map(res[[i]], ~bind_rows(.))
  }

  fixed_df = res %>%
    bind_rows() %>%
    filter(errorI < error_prev,
           power > power_prev)

  return(fixed_df)
}
```

```
fixed(maxn = 100, null = 0.05, alt = 0.2, error_prev = 0.0804, power_prev = .9041)
```

```
## # A tibble: 223 x 4
##       i     j errorI power
##   <int> <int>   <dbl> <dbl>
## 1     32     4 0.0738 0.907
## 2     39     5 0.0438 0.913
## 3     40     5 0.0480 0.924
## 4     41     5 0.0525 0.934
## 5     42     5 0.0573 0.942
## 6     43     5 0.0623 0.949
## 7     44     5 0.0675 0.956
## 8     45     5 0.0729 0.962
## 9     45     6 0.0239 0.910
## 10    46     5 0.0786 0.967
## # ... with 213 more rows
```

The sample size 32 with a response of 4 or more subjects satisfies these parameters.

There is 0.07381 probability of rejecting the null with this outcome under the null.

Under the alternative, there is 0.9069 probability for rejecting this outcome.

The number of participants required for an adaptive design trial if the futility trial is successful is 2 more than for the adaptive model.

However, the adaptive model has an expected sample size of only 17, which is 15 fewer than in the fixed design.