MA677 HW1

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Chapter2 of G&S, Example 3.11.

The authors write "A few experiments have shown us that m = 69 is the smallest value for m that thwarts a type 1 error, while m = 73 is the largest which thwarts a type 2." They report the results but don't show their experiments. Similarly, they show the power curve in Figure 3.7. but not how it was produced. This assignment is to fill in these gaps.

Find critical values

Using experiments and for-loop

```
n = 100

# Generate a function for alpha(p)
alpha <- function(m, n, p){
  sum(dbinom(m:n, n, p))
}
# Get critical value by different experiment
cat("If critical value = 64, the type-I error is",alpha(64,n,0.6))
```

```
## If critical value = 64, the type-I error is 0.2386107
```

```
cat("If critical value = 68, the type-I error is",alpha(68,n,0.6))
```

```
## If critical value = 68, the type-I error is 0.06150391
```

```
cat("If critical value = 69, the type-I error is",alpha(69,n,0.6))
```

```
## If critical value = 69, the type-I error is 0.03984788
```

```
cat("If critical value = 78, the type-II error is",1-alpha(78,n,0.8))
```

```
## If critical value = 78, the type-II error is 0.2610672
```

```r
cat("If critical value = 74, the type-II error is",1-alpha(74,n,0.8))
```

```
## If critical value = 74, the type-II error is 0.05583272
```

```r
cat("If critical value = 73, the type-II error is",1-alpha(73,n,0.8))
```

```
## If critical value = 73, the type-II error is 0.03415163
```

```r
# Get critical value by for-loop
for(i in 60:n){
  if (alpha(i,n,0.6)<0.05){
    cat("The critical value for type-I error is",i)
    break;
  }
}
```

```
## The critical value for type-I error is 69
```

```r
for(j in 80:1){
  if ((1-alpha(j,n,0.8))<0.05){
    cat("The critical value for type-II error is",j)
    break;
  }
}
```

```
## The critical value for type-II error is 73
```

Explanation for the critical value m.

For type-I error we choose p=0.6 and for type-II error we choose p=0.8. As the book mentioned that increasing m above the most probable value np which is 100*0.6 = 60 will make type-I error less likely. Similarly, decreasing m below 80 will make type-II error less likely. Since we want both type-I and II error less than 0.05, we choose the critical value to be the smallest number making type-I error less than 0.05 and to be the largest number making type-II error less than 0.05. Then we can find that the critical value should be between 69 and 73 people cured.

Plot

```r
# Sequence for values on x axis when p is between 0.4 to 1.
x <- seq(0.4, 1, by = 0.01)

# Generate a function to get values of alpha(p) when p is between 0.4 to 1.
n_y<-c()
y<- function(m){
  for(g in x){
    a<-alpha(m,n,g)
    n_y<-c(n_y,a)
  }
```

```r
  n_y
}

# plot
ggplot()+
  geom_rect(aes(xmin = 0.6, xmax = 0.8, ymin = 0.05, ymax = 0.95), fill="transparent",color="gray44")+
  geom_line(aes(x,y(69)))+
  geom_line(aes(x,y(73)))+
  theme_classic()+
  theme(axis.title.x = element_blank())+
  theme(axis.title.y = element_blank())+
  labs(title = 'Figure 3.7: The power curve')
```