MA677 Assignment 1

Yuelin Jiang

2/9/2021

Assignment: Due – Wednesday, February 10

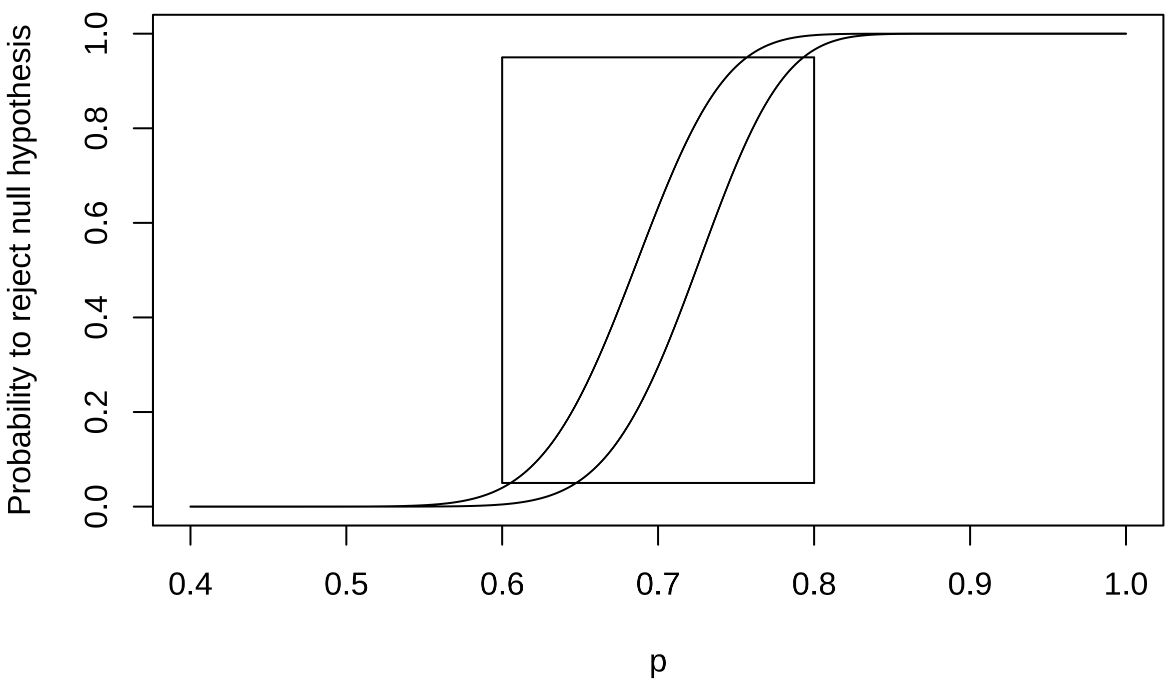
In Chapter 2 of G&S, Example 3.11 uses the binomial distribution to demonstrate the logic of hypothesis testing with a simple example.

The intuitive simplicity of the example and the availability of tools in R for calculations and plotting distributions encourages you to explore hypothesis testing by reproducing the results presented in the book.

In the final paragraph of the example on page 102, the authors write, "A few experiments have shown us that . . . ". They report the results but don't show you their experiments. Similarly, they show you Figure 3.7, but not how it was produced.

Your assignment is to fill in these gaps. Produce an explanation of the example showing how the authors reached their conclusion that the critical value should be between 69 and 73 people cured. Replicate and explain Figure 3.7.

Reproducing the graph in Figure 3.7

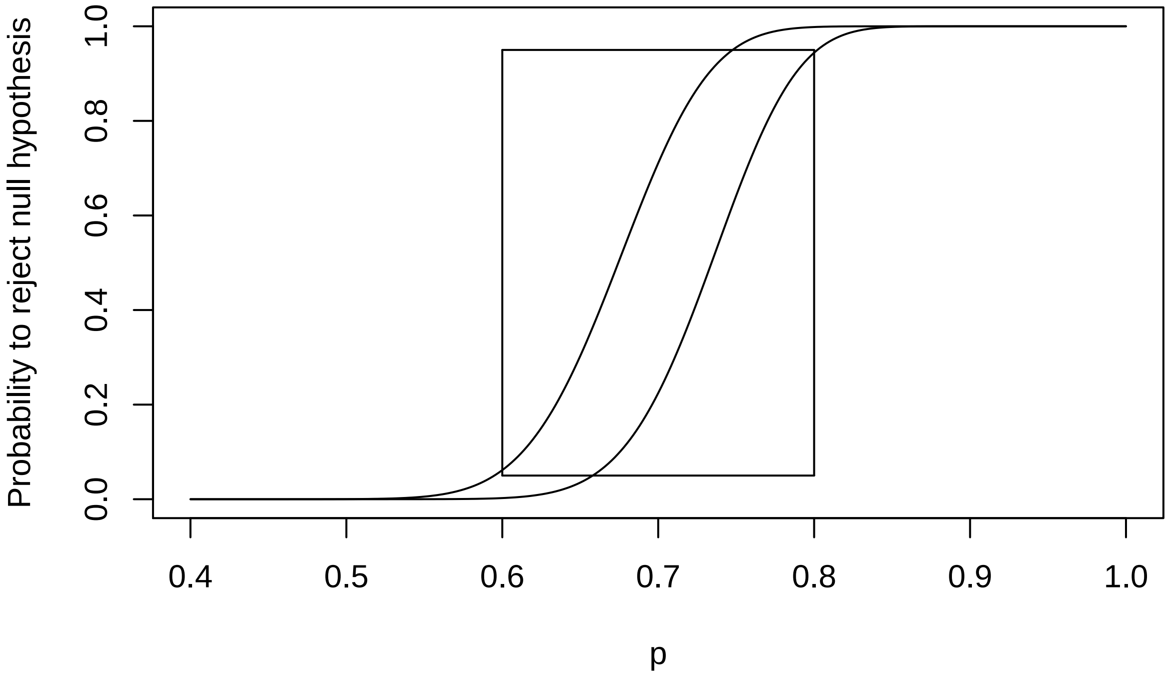


Explaining Critical Value from the above Graph

We conclude critical value to be between 69 and 73 inclusive. Graphically we have to choose critical values m which make our alpha function enters from the bottom of the box and exits from the top of the box. Within the box is our 90% significant range. Any m that make an alpha function enters or exits outside the bottom or top of the box increases our risks of Type I and Type II errors.

When p=0.6, we want the probability to reject the null hypothesis to be low to avoid Type I error. When p=0.8, we want the probability to reject the null hypothesis to be high to avoid Type II error.

For example, when critical value m = 68 and m = 74 are drawn, they enter and exit outside of our 90% range, as shown below:



When m = 68, alpha function–the probability to reject null hypothesis at p=0.6 is higher than 0.05. That means the probability to reject the null hypothesis that a drug with p=0.6 effectiveness is same as the original drug is higher than 5%. We have a higher than 5% chance of rejecting the null hypothesis when it's in fact correct, thus committing a Type I error.

When m = 74, our alpha function– the probability to reject null hypothesis at p = 0.8 is lower than 0.95, meaning the probability to accept that a much more effective drug(p=0.8) is no different than the original drug is higher than 0.05. We have a higher than 5% chance of accepting a null hypothesis when it's in fact wrong, thus committing a Type II error.

So we conclude critical values to be between 69 to 73. If we want to find critical values using code, we could use two for loops:

```r
# for loop to get minimum critical value
for (i in 60:n) {
  if(alpha(i,n,0.6) <0.05){
    cat("The minimum critical value to avoid Type I error is", i, ". ")
    break
  }
}
```

```
## The minimum critical value to avoid Type I error is 69 .
```

```r
for (i in 80:1) {
  if ( ((1- alpha(i, n, 0.8))<0.05 )){
    cat("The maximum critical value to avoid Type II error is", i, ".")
    break;
```

```
  }
}
```

```
## The maximum critical value to avoid Type II error is 73 .
```

Homework credit

Aoyi Li helped me with directly calculating the maximum and minimum critical values using for loop codes. Credits to her.