

677 Assignment 1

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2021/2/11

First, we calculate the alpha value, which is the probability of type 1 error. In the case that the textbbok mentioned, $p=0.6$ when $m=60$ people have been cured, and the total number of people are $n=100$. The probability function is written as

$$\alpha(p) = \sum_{m \leq k \leq n} b(n, p, k) = \sum_{60 \leq k \leq 100} b(100, 0.6, k)$$

```
# alpha when p=0.6
m1=rep(0,times=40)
P1=rep(0,times=40)
for(i in 0:40){
  m1[i]=i+60
  P1[i]=pbinom(q=100,size=100,prob=0.6)-pbinom(q=m1[i]-1,size=100,prob=0.6)
}
a=data.frame(cbind(m1,P1))
```

Next, we calculate the probability of type 2 error, which is beta value. The probability function can be written as the function of alpha, since beta value = 1 - alpha value. In this case, $p=0.8$ when $m=80$ people have been cured

```
m2=rep(0,times=20)
P2=rep(0,times=20)
for(i in 0:20){
  m2[i]=80-i
  P2[i]=pbinom(q=m2[i]-1,size=100,prob=0.8)
}
b=data.frame(cbind(m2,P2))
```

Now, we apply the criteria that alpha and beta value are less than 0.05 to filter out the value for m

```
m_a=a[which(a$P1<0.05),1]
min(m_a)
```

```
## [1] 69
```

```
m_b=b[which(b$P2<0.05),1]
max(m_b)
```

```
## [1] 73
```

```
intersect(m_a,m_b)
```

```
## [1] 69 70 71 72 73
```

Thus, we get the minimum m value for 69, which can make the alpha value less likely and m value for 73 which can make the beta value less likely.

power curve

write a program PowerCurve to plot, for $n = 100$ and selected values of m, the function $\alpha(p)$, for p ranging from .4 to 1.

For the x-axis, this is the probability that new drug is effective.

```
p=seq(from=0.4,to=1,length=100)
```

For the y-axis, that is the probability of the type 1 error

```
#when m=69
alpha1=rep(0,times=length((p)))
for(i in 1:100){
  alpha1[i]=pbinom(q=100,size=100,prob=p[i])-pbinom(q=68,size=100,prob=p[i])
}
```

```
#for m=73
alpha2=rep(0,times=length((p)))
for(i in 1:100){
  alpha2[i]=pbinom(q=100,size=100,prob=p[i])-pbinom(q=72,size=100,prob=p[i])
}
```

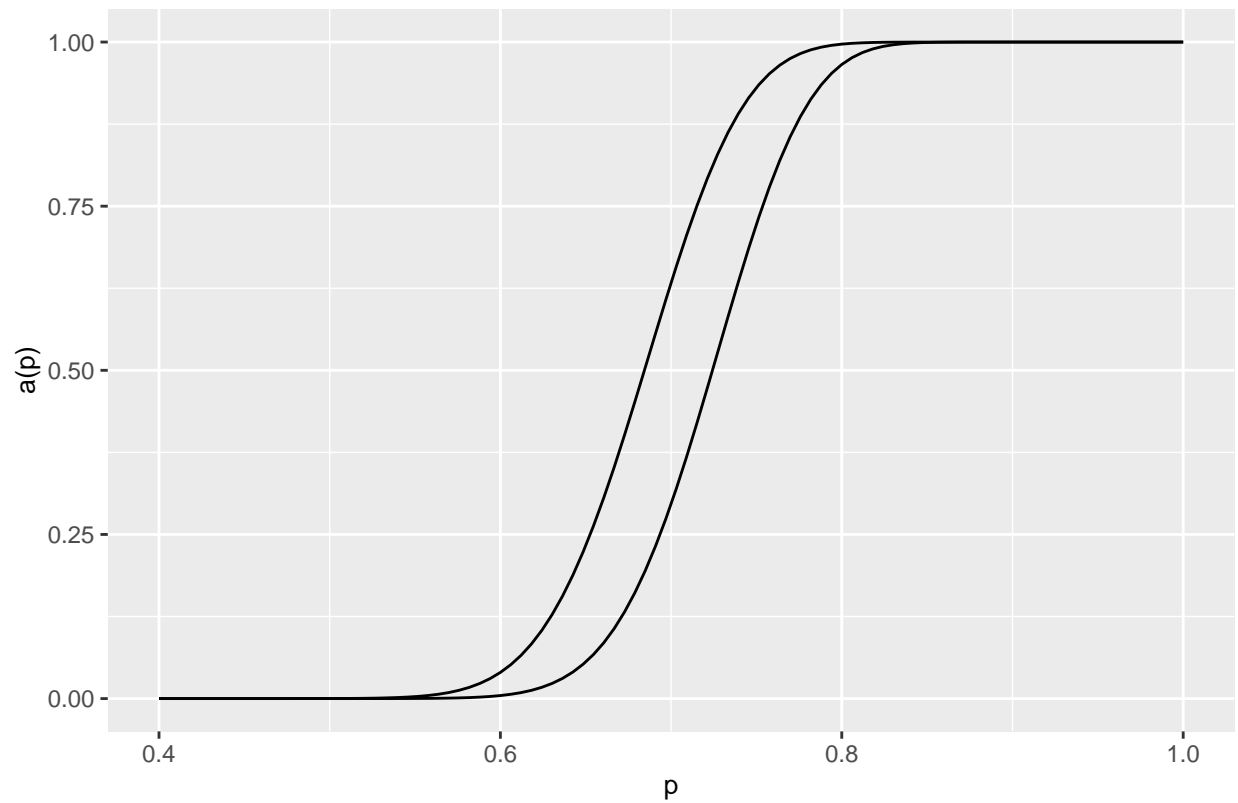
We combine alpha1 and alpha2

```
type_error=data.frame(cbind(p,alpha1,alpha2))
```

Now we can plot our curve

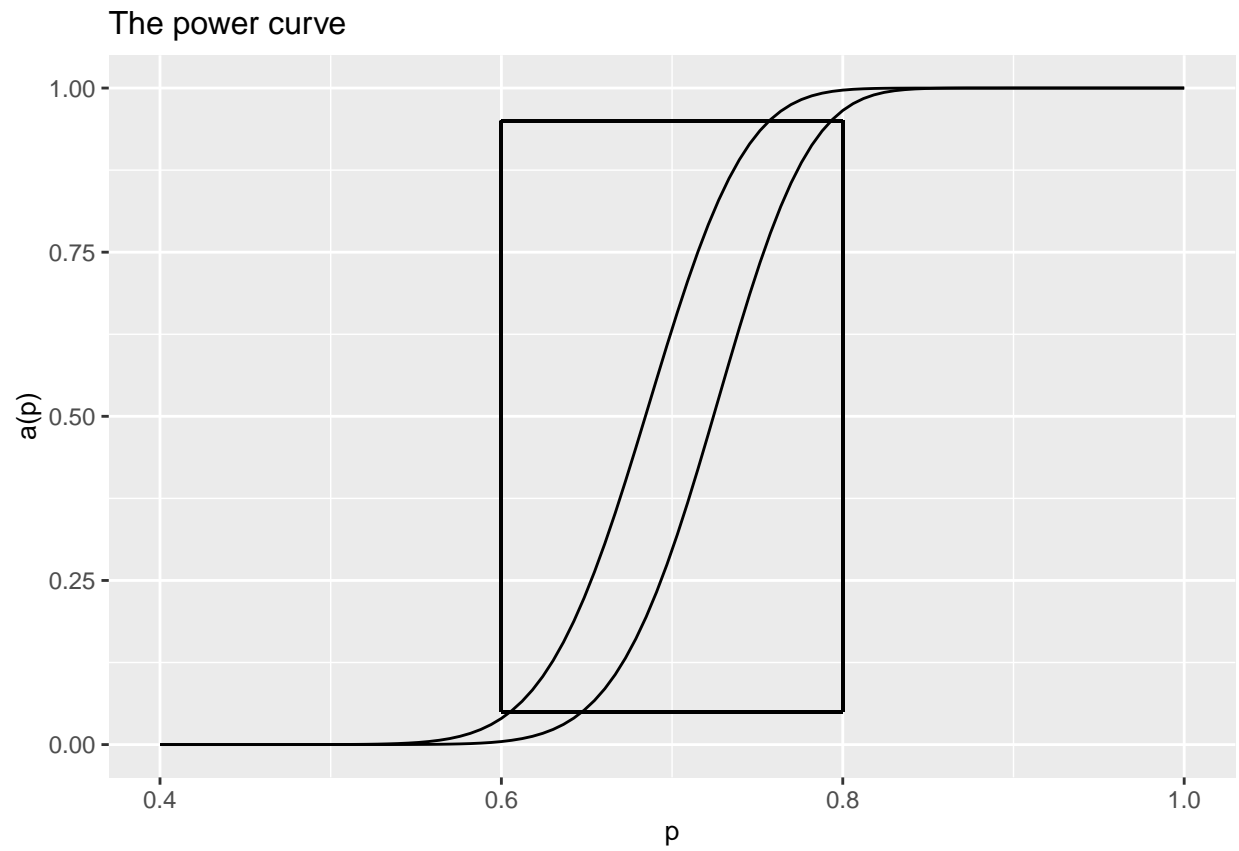
```
powercurve=ggplot(data=type_error,mapping=aes(x=p))+
  geom_line(mapping=aes(y=alpha1))+
  geom_line(mapping=aes(y=alpha2))+
  labs(x="p",y="a(p)",title="The power curve")+
  theme(title=element_text(hjust=0.5,size=10))
powercurve
```

The power curve



Finally, we add the box which range from 0.05 to 0.95

```
powercurve+  
  geom_segment(mapping=aes(x=0.6,xend=0.8,y=0.05,yend=0.05))+  
  geom_segment(mapping=aes(x=0.6,xend=0.8,y=0.95,yend=0.95))+  
  geom_segment(mapping=aes(x=0.6,xend=0.6,y=0.05,yend=0.95))+  
  geom_segment(mapping=aes(x=0.8,xend=0.8,y=0.05,yend=0.95))
```



Note: I collaborate with yuxin zeng to finish this assignment.