Lsn 10 - MA206Y

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Admin

Effect Estimation

Recall that π and μ are called:

And the goal of statistics is to find something out about these values. The only way we will truly know π or μ is if we sample:

This is often unrealistic, so we do an experiment and observe $\hat{p}$ or $\bar{X}$. Do you think that $\hat{p} = \mu$? Will this ever be true?

DPE is interested in the percentage of Male cadets that pass the IOCT.

```
library(tidyverse)
apft<-read.csv("APFT.csv")
males.explore<-apft %>% filter(sex=="M") %>% mutate(pass=IOCT_Time<211)%>%
  group_by(pass)%>%summarise(count=n())
males.explore
```

```
## # A tibble: 2 x 2
##   pass  count
##   <lgl> <int>
## 1 FALSE    31
## 2 TRUE    249
```

What is $\hat{p}$ here? What is n?

Does this give us π? What if we wanted to prove that $\pi \neq 0.05$? What would H_0 and H_a be?

Using a simulation based method we could do:

```
phat=31/(249+31)
pi=0.05
trials=280
M=1000
outcomes=2
stats=data.frame(trial=seq(1,M),result=NA)
```

```
for(i in 1:M){
  simulation=rbinom(trials,outcomes-1,pi)
  stats[i,]$result=sum(simulation)/trials
}

p.value=stats %>% filter(result>phat|result < pi-(phat-pi))%>%summarise(pval=n()/M)
p.value
```

```
##   pval
## 1    0
```

What would our conclusion be if we were willing to risk $\alpha = .05$?

What if we were testing $\pi = 0.09$?

So there's a tipping point where we would switch from rejecting to not rejecting. Let's go to the applet and see if we can't find that point. Let's include the π we are testing and the proportion of 'as extreme or more extreme' observations:

So we're fairly certain that π cannot be:

Note we haven't proven what π is, but we've given a range of values that we are fairly confident that our true proportion of Cadet males who fail the IOCT is.

This is a **Confidence Interval**. In particular this would be considered a 95% confidence interval. What if we were only willing to consider $\alpha = 0.01$? According to our table what would our tipping points be?

There's a couple of interpretations of Confidence intervals that are generally accepted to be true. The first is 'we are XXX percent confident that π lies between ZZZ and YYY'. This is ok. Another interpretation is if we repeated our experiment over and over and over again, about XXX percent of the time π would fall between ZZZ and YYY. This, in my opinion, is a bit better of an interpretation, but they both are fine for this course. What is NOT fine is: XXX percent of our data lies between ZZZ and YYY. Or, there is a XXX probability that π is between ZZZ and YYY.

Just like for hypothesis testing there is a theory based approach for finding confidence intervals. Note that our validity condition is the exact same as before. Which are:

If these are met, then we know:

For a confidence interval, though, we have to change one small thing. In particular we aren't testing a hypothesis for a single π_0 so we need something else in the denominator. For forming a CI we use:

$$z = \frac{\hat{p} - \pi}{\sqrt{\hat{p}(1-\hat{p})/n}}$$

This leads to the following formula for a $100(1-\alpha)$ confidence interval:

$$\hat{p} \pm z_{1-\alpha/2}\sqrt{\hat{p}(1-\hat{p})/n}$$

Our book refers to $z_{1-\alpha/2}$ as the multiplier. What I'm saying here is:

So to find a 95% CI we would need the spot on our X axis so that the area under the curve is 1-.05/2=.975. Or

```
qnorm(.975)
```

```
## [1] 1.959964
```

For a 99% CI we would need 1-.01/2=.995

```
qnorm(.995)
```

```
## [1] 2.575829
```

So, four our IOCT data, using $z_{1-\alpha/2} = 1.96$ or $\alpha = .05$ find a 95 % CI

We can get the same thing in R by using `prop.test`

```
prop.test(x=31,n=(249+31),alternative="two.sided",conf.level=0.95,correct=F)
```

```
##
##  1-sample proportions test without continuity correction
##
## data:  31 out of (249 + 31), null probability 0.5
## X-squared = 169.73, df = 1, p-value < 2.2e-16
## alternative hypothesis: true p is not equal to 0.5
## 95 percent confidence interval:
##  0.07910122 0.15286440
## sample estimates:
##         p
```

```
## 0.1107143
```

What would we have to change for a 99% CI? What about a 90% CI?

The Gallup organizaiton conducted a survey with a random sample of 1,019 adult Americans on Decmeber 10-12, 2010. They found that 80 % of the respondents agreed with the statement that the US has a unique character that makes it the greatest country in the world.

In words, what is the population and what is the sample?

Is $\pi = 0.8$ where pi is the proportion of Americans who agree with the statement?

Is it plausible that $\pi = 0.775$? Use the applet to explore this. Click on Summary stats. How many standard deviation is 0.775 from 0.80?

Note that `qnorm(.975)` yields a value of about 2, so a quick and dirty way to find a 95% CI is to take $hatp \pm 2sd(\hat{p})$ Using the SD you found in the simulation, do this.

Interpret this CI

Can we use a theory based method here? Why or why not?

According to the theory based method $sd(\hat{p}) = \sqrt{\hat{p}(1-\hat{p})/n}$ What is this value and how does it compare to your simulations?

Use the theory based method to construct an 85% CI, is it wider or narrower than a 95% CI?