Problem Set 9

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Question 1

One sample Z test.

16 is not within the bounds of our confidence interval, which suggests that the sample mean is significantly different from 16.

$\overline{X} = \frac{\sum x}{9} = 16.95333$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{X_n})^2}{n-1}} = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \overline{16.95333})^2}{8}} = \sqrt{\frac{9.0978}{8}} = 1.066408$$

$$se = \frac{\sigma}{\sqrt{n}} = \frac{1.066408}{\sqrt{9}} = \frac{1.066408}{3} = 0.3554693$$

$$CI(\alpha) = [\overline{X} - z_{\alpha/2} * se, \overline{X} + z_{\alpha/2} * se]$$

$$CI(\alpha = 0.1) = [16.95333 - (1.644854 * 0.3554692), 16.95333 + (1.644854 * 0.3554692)]$$

$$CI(\alpha = 0.1) = [16.95333 - (0.5846949), 16.95333 + (0.5846949)]$$

$$CI(\alpha = 0.1) = [16.36864, 17.53803]$$

$$z\ score = \frac{\overline{X} - \mu}{\sqrt{\sigma^2/n}} = \frac{16.95333 - 16}{1.066408/\sqrt{9}} = \frac{0.95333}{0.3554692} = |2.681892| > 1.64 = Reject\ Null$$

Question 2

The evidence suggests that the students on the new platform finish their learning modules significantly faster than industry standard.

$$\frac{\overline{X} - \mu}{\sqrt{\sigma^2/n}} = \frac{37 - 40}{5/\sqrt{50}} = \frac{-3}{0.7071068} = -4.242641 < -2.404892 = Reject\ Null$$

Question 3

$H_0 : Allergy\ (p) < 0.1$

$H_1 : Allergy\ (\hat{p}) \geq 0.1$

$t\ statistic = -0.3447674$

$p\ value = 0.6347036$

At $\alpha = 0.5$, we would fail to reject the null hypothesis.

$$SE\ Sample\ Proportion = \sqrt{\frac{\hat{p}(1-\hat{p})}{n-1}} = \sqrt{\frac{0.0933(0.9067)}{224}} = \sqrt{\frac{0.08459511}{224}} = 0.01943339$$

$$t\ statistic = \frac{\hat{p}-p}{\sqrt{\frac{p(1-p)}{n-1}}} = \frac{0.0933-0.1}{0.01943339} = \frac{-0.0067}{0.01943339} = -0.3447674$$

```
n=225
p.hat <- 0.0933
mu=0.1
df=224

se<- sqrt((p.hat*(1-p.hat))/224)

p.value<-pt(q= -0.3447674, df=224, lower.tail = F)
print(p.value)
```

```
## [1] 0.6347036
```

Question 4

At 80% power, a sample size of 78 is needed for an effect size of 0.4. For an effect size of 0.5, a sample size of 51 is needed. Finally, for an effect size of 0.6, a sample size of 36 is needed.

```
library(pwr)

#right-tailed - improving


D<-c(0.4, 0.5, 0.6)
X<-c()

for(i in D){
  x<-power.t.test(delta = i, sd = 1, type = "two.sample",
               alternative = "one.sided", power = 0.8)
  X<-c(X,x)
}

X
```

```
## $n
## [1] 77.96726
##
## $delta
## [1] 0.4
##
## $sd
## [1] 1
##
## $sig.level
## [1] 0.05
##
## $power
## [1] 0.8
##
## $alternative
## [1] "one.sided"
##
## $note
## [1] "n is number in *each* group"
##
## $method
## [1] "Two-sample t test power calculation"
##
## $n
## [1] 50.1508
##
## $delta
## [1] 0.5
##
## $sd
## [1] 1
##
## $sig.level
## [1] 0.05
##
## $power
## [1] 0.8
##
## $alternative
## [1] "one.sided"
##
## $note
## [1] "n is number in *each* group"
##
## $method
## [1] "Two-sample t test power calculation"
##
## $n
## [1] 35.04404
##
## $delta
## [1] 0.6
##
```

```
## $sd
## [1] 1
##
## $sig.level
## [1] 0.05
##
## $power
## [1] 0.8
##
## $alternative
## [1] "one.sided"
##
## $note
## [1] "n is number in *each* group"
##
## $method
## [1] "Two-sample t test power calculation"
```