Homework #8

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```
knitr::opts_chunk$set(echo = TRUE, highlight=FALSE, warning = FALSE)
```

Insert packages/Set seed

```
# Set Seed
set.seed(10062002)
```

Problem 1

Part a

```
# Empirical Type 1 Error
question1afunc <- function(x, y){
  samp <- rbinom(1, 107, 0.5)
  z.prop2 <- prop.test(samp, 107, p=0.5, alternative=x, correct=y)
  z.prop2$p.value <= 0.05
}

#a Left-tailed without the continuity correction
left <- sum(replicate(10000, question1afunc("less", FALSE)))/10000

#b Left-tailed with the continuity correction
leftcont <- sum(replicate(10000, question1afunc("less", TRUE)))/10000

#c Right-tailed without the continuity correction
right <- sum(replicate(10000, question1afunc("greater", FALSE)))/10000

#d Right-tailed with the continuity correction
rightcont <- sum(replicate(10000, question1afunc("greater", TRUE)))/10000

#e Two-tailed without the continuity correction
two <- sum(replicate(10000, question1afunc("two.sided", FALSE)))/10000

#f Two-tailed with the continuity correction
twocont <- sum(replicate(10000, question1afunc("two.sided", TRUE)))/10000
```

Part b

```
# Empirical Power
question1bfunc <- function(x, y, z){
  samp <- rbinom(1, 107, 0.5)
  z.prop2 <- prop.test(samp, 107, p=z, alternative=x, correct=y)
  z.prop2$p.value <= 0.05
}

#a Left-tailed without the continuity correction
pleft <- sum(replicate(10000, question1bfunc("less", FALSE, 0.57)))/10000
```

```
#b Left-tailed with the continuity correction
pleftcont <- sum(replicate(10000, question1bfunc("less", TRUE, 0.57)))/10000

#c Right-tailed without the continuity correction
pright <- sum(replicate(10000, question1bfunc("greater", FALSE, 0.43)))/10000

#d Right-tailed with the continuity correction
prightcont <- sum(replicate(10000, question1bfunc("greater", TRUE, 0.43)))/10000

#e Two-tailed without the continuity correction
ptwo <- sum(replicate(10000, question1bfunc("two.sided", FALSE, 0.45)))/10000

#f Two-tailed with the continuity correction
ptwocont <- sum(replicate(10000, question1bfunc("two.sided", TRUE, 0.45)))/10000
```

Part c

```
# Summary Table
anocorrection <- c(left, right, two)
acorrection <- c(leftcont, rightcont, twocont)
df1 <- data.frame(anocorrection, acorrection)
row.names(df1) <- c("Left Tail", "Right Tail", "Two-Tail")
colnames(df1) <- c("alpha without Correction", "alpha with Correction")
print(df1)
```

```
##            alpha without Correction alpha with Correction
## Left Tail                    0.0391                0.0412
## Right Tail                   0.0396                0.0430
## Two-Tail                     0.0561                0.0322
```

```
pnocorrection <- c(pleft, pright, ptwo)
pcorrection <- c(pleftcont, prightcont, ptwocont)
df2 <- data.frame(pnocorrection, pcorrection)
row.names(df2) <- c("Left Tail", "Right Tail", "Two-Tail")
colnames(df2) <- c("power without Correction", "power with Correction")
print(df2)
```

```
##            power without Correction power with Correction
## Left Tail                    0.4258                0.4292
## Right Tail                   0.4187                0.4133
## Two-Tail                     0.1652                0.1673
```

Problem 2

Part a

```
# Empirical Type 1 Error
question2afunc <- function(x, y){
  samp <- rbinom(1, 107, 0.08)
  z.prop2 <- prop.test(samp, 107, p=0.08, alternative=x, correct=y)
  z.prop2$p.value <= 0.05
}

#a Left-tailed without the continuity correction
left2 <- sum(replicate(10000, question2afunc("less", FALSE)))/10000

#b Left-tailed with the continuity correction
leftcont2 <- sum(replicate(10000, question2afunc("less", TRUE)))/10000

#c Right-tailed without the continuity correction
right2 <- sum(replicate(10000, question2afunc("greater", FALSE)))/10000

#d Right-tailed with the continuity correction
rightcont2 <- sum(replicate(10000, question2afunc("greater", TRUE)))/10000

#e Two-tailed without the continuity correction
two2 <- sum(replicate(10000, question2afunc("two.sided", FALSE)))/10000

#f Two-tailed with the continuity correction
twocont2 <- sum(replicate(10000, question2afunc("two.sided", TRUE)))/10000
```

Part b

```
# Empirical Power
question2bfunc <- function(x, y, z){
  samp <- rbinom(1, 107, 0.08)
  z.prop2 <- prop.test(samp, 107, p=z, alternative=x, correct=y)
  z.prop2$p.value <= 0.05
}

#a Left-tailed without the continuity correction
pleft2 <- sum(replicate(10000, question2bfunc("less", FALSE, 0.12)))/10000
```

```
#b Left-tailed with the continuity correction
pleftcont2 <- sum(replicate(10000, question2bfunc("less", TRUE, 0.12)))/10000

#c Right-tailed without the continuity correction
pright2 <- sum(replicate(10000, question2bfunc("greater", FALSE, 0.03)))/10000

#d Right-tailed with the continuity correction
prightcont2 <- sum(replicate(10000, question2bfunc("greater", TRUE, 0.03)))/10000

#e Two-tailed without the continuity correction
ptwo2 <- sum(replicate(10000, question2bfunc("two.sided", FALSE, 0.05)))/10000

#f Two-tailed with the continuity correction
ptwocont2 <- sum(replicate(10000, question2bfunc("two.sided", TRUE, 0.05)))/10000
```

Part c

```
# Summary Table
anocorrection2 <- c(left2, right2, two2)
acorrection2 <- c(leftcont2, rightcont2, twocont2)
df3 <- data.frame(anocorrection2, acorrection2)
row.names(df3) <- c("Left Tail", "Right Tail", "Two-Tail")
colnames(df3) <- c("alpha without Correction", "alpha with Correction")
print(df3)
```

```
##            alpha without Correction alpha with Correction
## Left Tail                    0.0233                0.0252
## Right Tail                   0.0462                0.0459
## Two-Tail                     0.0481                0.0306
```

```
pnocorrection2 <- c(pleft2, pright2, ptwo2)
pcorrection2 <- c(pleftcont2, prightcont2, ptwocont2)
df4 <- data.frame(pnocorrection2, pcorrection2)
row.names(df4) <- c("Left Tail", "Right Tail", "Two-Tail")
colnames(df4) <- c("power without Correction", "power with Correction")
print(df4)
```

```
##            power without Correction power with Correction
## Left Tail                    0.3774                0.2359
## Right Tail                   0.7635                0.7633
## Two-Tail                     0.3570                0.2314
```

Problem 3

The continuity correction used within the prop.test( ) function is an adjustment that is made to statistical tests when discontinuous distributions (such as a binomial distribution) are approximated by continuous ones (such as normal distributions). Usually, this correction is used to prevent the overestimation of statistical significance for small data. Before statistical software had the ability to evaluate probability distribution functions accurately, continuity corrections player an important role in the practical application of tests. Where extreme accuracy is not necessary, computer calculations may still rely on using continuity corrections, but with large data supported by modern computational abilities the continuity correction is often not used. For the one-sample proportion test specifically, the continuity correction risks sizable error when working with small sample sizes, sample proportions near 0 or 1.0, and/or null proportions far from 0.5.

When considering the results of questions 1 and 2, the continuity correction – when used for the one-sample z-test for proportions when the sample size is large enough for the approximate normality assumption to hold – has little effect on the empirical alpha and power values. For both the success rate of 50% and 8% (a moderate and extreme null value), the differences between the empirical alpha and power when the continuity correction is applied are negligible. The only noticeable difference occurs for values of the two-tailed one sample z-test for proportions. In this case, both the alpha and power values are usually much different from their original respective values because the code must correct in both directions, therefore widening the difference between the original and the correction. In regards to the left- and right-tailed tests, these directions have little difference between the empirical alpha and power when the correction is used. To discuss the effect size and power of the previous questions, the only test to almost reach the 80% power threshold was the right-tailed test of the extreme null value (8%). This is true whether the test used or did not use a continuity correction. A more broad conclusion, however, is that the measures of power and effect size are relatively similar regardless as to whether the continuity correction is used. There are small differences, yet it is not the difference between a satisfactory power rate (80%+) and one that is not.

Source referenced: https://data.library.virginia.edu/continuity-corrections-imperfect-responses-to-slight-problems/