Math 247: Homework 4

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Rock-paper-scissors

In Example 1.2, we investigated some results of the game rock-paper-scissors. In the article referenced in the example, the researchers had 119 people play rock-paper-scissors against a computer. They found 66 players (55.5%) started with rock, 39 (32.8%) started with paper, and 14 (11.8%) started with scissors. We want to see whether players start with scissors with a long-term probability that is different than 1/3.

a. State the appropriate null and alternative hypotheses in the context of this study, first in words and then in symbols.

Null: The long-term probability that a player chooses scissors is 1/3, $\pi = 1/3$ Alternate: The long-term probability that a player chooses scissors is not 1/3, $\pi \neq 1/3$

b. Using R, find the p-value using a theory-based test (one-proportion z-test; normal approximation). Hint: use R code from exploration 1.5

```r
n <- 119
pi <- 1/3
p.hat <- 14/119
SD.Theory.null <- sqrt(pi*(1-pi)/n)
z <- (p.hat - pi)/SD.Theory.null
one.sided.p.value <- round(pnorm(z, mean=0, sd = 1, lower.tail = TRUE),10)
two.sided.p.value <- 2*one.sided.p.value
cat("Sample size = ", n,
"\nPopulation proportion =", pi,
"\nStandard Deviation of the theory-based null distribution = ", SD.Theory.null,
"\nThe standardized statistic z using theory is ", z,
"\nThe theory based p.value is", two.sided.p.value)
```

```
## Sample size =  119
## Population proportion = 0.3333333
## Standard Deviation of the theory-based null distribution =  0.04321358
## The standardized statistic z using theory is  -4.991169
## The theory based p.value is 6.002e-07
```

c. Summarize your conclusion from your p-value.

We have very strong evidence against the null hypotheses.

d. What is the value of the standardized statistic? What does it measure?

$z = -5.75$, our statistic is 5.75 standard deviations above the mean.

e. Are validity conditions for using a normal approximation satisfied? Explain

Yes, because we have at least 10 players who started with scissors and at least 10 who didn't.

Haircuts

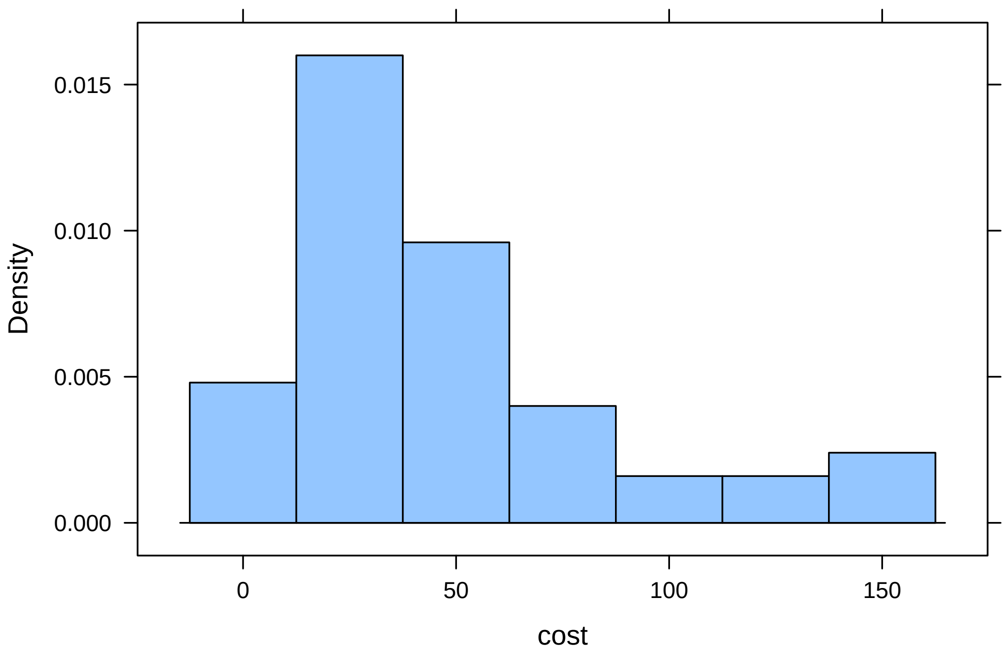
Students in a statistics class were asked the cost of their last haircut. The dataset can be found on the textbook website as `HaircutCosts`.

```
data(HaircutCosts)#load the data
head(HaircutCosts, n=2)# print the two first rows of the data
```

```
##   cost
## 1   20
## 2   75
```

a. Create a histogram of the cost of their last haircut.Is the distribution of haircut costs symmetric, skewed to the left, skewed to the right, or something else?

```
histogram(~cost, data=HaircutCosts)
```



It appears to be skewed right.

b. Would you think the mean haircut cost is about the same as the median, higher than the median, or lower than the median? Why?

Higher than the median since our data is skewed right.

c. Find and report both the mean and median haircut costs. Were you correct in your answer to part (b)?

```
favstats(~cost, data=HaircutCosts)[c("mean","median")]
```

```
##   mean median
##  45.68     35
```

d. The highest haircut cost is $150 and there were three of these. Suppose one of the students who reported $150 actually had a haircut cost of $300 but reported it to be $150. If this student's haircut value were changed, how, if at all, would it change the mean haircut cost for the class? How, if at all, would it change the median?

The mean would increase, but the median would stay the same

True or False?

a. Random samples only generate unbiased estimates of long-run proportions, not long-run means.

False

b. Nonrandom samples are always biased.

False

c. There is no way that a sample of 100 people can be representative of all adults living in the United States.

False

Notation

a. What symbol is used for a population proportion (parameter)?

$$\pi$$

b. What symbol is used for sample proportion?

$$\hat{p}$$

c. What symbol is used for sample mean?

$$\overline{x}$$

d. what symbol is used for population mean?

$$\mu$$

e. What symbol is used for sample standard deviation?

$$s$$

f. What symbol is used for population standard deviation?

$$\sigma$$