Lecture 22 Work

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11/27/2019

Problem 1

```
alpha <- 0.05
n <- 62
xbar <- 1.911  # sample statistic
s <- 1.065      # DO NOT USE 'mean' or 'sd' as variables
mu <- 1.80
SE <- s / sqrt(n)
z_test <- ( xbar - mu) / SE
z_test
```

```
## [1] 0.8206712
```

Then the p-value is:

```
p_val <- pnorm(z_test, lower.tail = FALSE)
p_val
```

```
## [1] 0.2059168
```

```
p_val < alpha
```

```
## [1] FALSE
```

Problem 2

The YSORT trial has data

```
n <- 291
alpha <- 0.01
phat <- 239 / n
phat
```

```
## [1] 0.8213058
```

```
p0 <- 0.5
z_test <- (phat - p0) / sqrt( p0 * (1-p0) / n )
z_test
```

```
## [1] 10.96213
```

Thus, the p-value can be computed as

```
p_val <- pnorm(z_test, lower.tail = FALSE)
p_val
```

```
## [1] 2.905628e-28
```

```
p_val < alpha
```

```
## [1] TRUE
```

To find the CI:

```
SE_CI <- sqrt( phat * (1-phat) / n )
z_star <- qnorm(0.95 + 0.025)
phat + c(-1, 1) * z_star * SE_CI
```

```
## [1] 0.7772900 0.8653217
```

Therefore the YSORT method appears to be associated with a proportion of boys being born between 0.777 and 0.865, with 95% confidence, or (0.777, 0.865).

Problem 3

The highway patrol says that the average speed is less than 105.

```
n <- 12
xbar <- 97.6
s <- 6.56
mu <- 105
alpha <- 0.05
t_test <- ( xbar - mu ) / ( s / sqrt(n) )
t_test
```

```
## [1] -3.907676
```

```
p_val <- pt(t_test, df = n-1, lower.tail = TRUE)  # HA was <105 => go to the left
p_val
```

```
## [1] 0.001222043
```

Therefore we do have evidence at the 95% level to reject the null, and conclude that the average speed on the I-280 at 3:30pm on a Wednesday is, indeed, less than 105 km/hr, as the Highway Patrol indicated.

We are also asked for a 99% confidence interval for the mean speed:

```
t_star <- qt(0.99 + 0.005, df = n - 1, lower.tail = TRUE)
t_star
```

```
## [1] 3.105807
```

```
qt(0.005, df = n-1, lower.tail = FALSE)
```

```
## [1] 3.105807
```

```
xbar + c(-1, 1) * t_star * s / sqrt(n)
```

```
## [1]  91.71851 103.48149
```

Therefore a 99% confidence interval for the mean speed on the I-280 at 3:30pm on a Wednesday is (91.7, 103.5) km/hr.

Problem 4

The US Mint is interested in penny weights.

```
n <- 35
xbar <- 2.49910
s <- 0.01648
alpha <- 0.05
```

```r
mu <- 2.500
z_test <- (xbar - mu) / ( s / sqrt(n) )
z_test
```

```
## [1] -0.3230869
```

```r
p_val <- pnorm(z_test, lower.tail = TRUE) * 2
p_val
```

```
## [1] 0.7466294
```

```r
p_val < alpha
```

```
## [1] FALSE
```

We fail to reject the null. We do not have evidence at the 95% level to conclude that the mean weight of post-1983 pennies is not equal to 2.500.

We are also asked for a 99% confidence interval.

```r
z_star <- qnorm(0.99 + (1-0.99) / 2)
CI <- xbar + c(-1, 1) * z_star * s / sqrt(n)
CI
```

```
## [1] 2.491925 2.506275
```

Therefore the confidence interval is from 2.492 to 2.506.

Problem 5

Danish cell phone user problem.

```r
n <- 420095
p0 <- 0.000340
n * p0
```

```
## [1] 142.8323
```

```r
n * (1 - p0)
```

```
## [1] 419952.2
```

$$H_0 : p = 0.000340 \text{ versus } H_A : p \neq 0.000340$$

```r
phat <- 125 / n
z_test <- (phat - p0) / sqrt( p0 * (1-p0) / n )
z_test
```

```
## [1] -1.492341
```

```r
p_val <- pnorm(z_test, lower.tail = TRUE) * 2
p_val
```

```
## [1] 0.1356098
```

```r
p_val < 0.005
```

```
## [1] FALSE
```

So we do not reject the null. That is, we conclude that we do not have evidence to conclude that the incidence rate of brain and nervous system cancer among cell phone users is any different to that of non-cell phone users, that is, we cannot conclude $p \neq 0.000340$.

Problem 6

For Zopiclone, we have

```
n <- 16
mu <- 102.8
xbar <- 98.9
s <- 42.3
alpha <- 0.05
t_test <- (xbar - mu) / (s / sqrt(n))
t_test
```

```
## [1] -0.3687943
```

```
p_val <- pt(t_test, df = n-1, lower.tail = TRUE)  # H_A: < 102.8, so go LEFT
p_val
```

```
## [1] 0.3587172
```

```
p_val < alpha
```

```
## [1] FALSE
```

Therefore, we do not have evidence at the 95% level to conclude that the application of Zopiclone reduced the mean awake time; we fail to reject the null hypothesis.

For a 95% confidence interval, we just:

```
t_star <- qt(0.95 + 0.05/2, df = n-1, lower.tail = TRUE)
xbar + c(-1, 1) * t_star * s/sqrt(n)
```

```
## [1]  76.35992 121.44008
```