ICA 5

Derien Weatherspoon

2023-02-22

```
attach(mtcars)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.4.0     v purrr   1.0.1
## v tibble  3.1.8     v dplyr   1.1.0
## v tidyr   1.3.0     v stringr 1.5.0
## v readr   2.1.3     v forcats 1.0.0
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

Question 1

Examine the qsec field in the dataset. Calculate its mean, standard deviation, and standard error. The following questions assume that the qsec field is normally distributed.

```
mean(mtcars$qsec)
```

```
## [1] 17.84875
```

```
sd(mtcars$qsec)
```

```
## [1] 1.786943
```

```
std.error <- function(x){ sd(x)/sqrt(length(x))
}
std.error(mtcars$qsec)
```

```
## [1] 0.3158899
```

Question 2

(a) Construct a 95% 2-sided confidence interval for the mean of the qsec field.
(b) Then, construct a 99% 1-sided confidence interval (lower limit).
(c) What would the result be for the 99% confidence interval if you used a normal distribution in place of the t-distribution?

```r
#a
attach(mtcars)
```

```
## The following object is masked from package:ggplot2:
##
##     mpg
```

```
## The following objects are masked from mtcars (pos = 12):
##
##     am, carb, cyl, disp, drat, gear, hp, mpg, qsec, vs, wt
```

```r
qsec.model <- lm(qsec ~ 1, mtcars) # mean of qsec
t.test(qsec)$conf.int # 95% confidence interval
```

```
## [1] 17.20449 18.49301
## attr(,"conf.level")
## [1] 0.95
```

```r
#b
confint(qsec.model,level = 0.99) # 99% confidence interval?
```

```
##                0.5 %   99.5 %
## (Intercept) 16.98193 18.71557
```

```r
#c
sd_q <- sd(mtcars$qsec)
sqrt_q <- sqrt(length(mtcars$qsec))
mean_q <- mean(mtcars$qsec)
new_CI <- qnorm(.99)*sd_q/sqrt_q
lower = mean_q - new_CI
lower
```

```
## [1] 17.11388
```

Question 3

How large would the sample size have to be if a 99% 2-sided confidence interval were to be 0.2 seconds wide (given the same standard deviation)?

Question 4

Suppose you want to show that the mean value is different from 17 seconds, at a 95% confidence level. Conduct a Monte Carlo simulation to determine whether you can falsify the null hypothesis. What is the p-value?

References

https://www.statology.org/standard-error-of-mean-r/ https://bookdown.org/logan_kelly/r_practice/p09.html