

Math 300 Lesson 24 Notes

Understanding Confidence Intervals

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Objectives

1. Explain how to construct a confidence interval using both the percentile method and the standard error method including assumptions.
2. Explain how changing the confidence level impacts the width of a confidence interval.

Reading

Chapter 8.3

Lesson

Work through the learning checks LC 8.3 - LC 8.4.

- All confidence intervals have the same interpretation. It is the construction that may differ.
- The reason we use an interval is because a point estimate has variation. Once we know the sampling distribution, we can construct an interval. Using the bootstrap gives us an estimate of the sampling distribution of the point estimate.
- We are going to do a look ahead and use R to construct the percentile method confidence interval.
- The percentile method is easier to understand but tends to be biased. There are many methods to adjust for this but for the purpose of this course both methods are acceptable.

Libraries

```
library(tidyverse)
library(moderndiver)
```

Review

As a review, let's construct the bootstrap distribution of the sample mean for our pennies data. This requires use to use our skills on wrangling data frames.

```
head(pennies_sample)
```

```
## # A tibble: 6 x 2
##   ID year
##   <int> <dbl>
## 1     1 2002
## 2     2 1986
## 3     3 2017
## 4     4 1988
## 5     5 2008
## 6     6 1983
```

Create and visualize a bootstrap distribution of the sample mean.

```
set.seed(52249)
# bootstrap_dist <- _____ %>%
#   rep_sample_n(size = _____, replace = _____, reps = _____) %>%
#   group_by(_____) %>%
#   summarize(_____)
```

```
# bootstrap_dist %>%
#   ggplot(aes(x=_____)) +
#   geom_histogram(binwidth = 1,
#                  color = "black",
#                  boundary = 1990,
#                  fill = "cyan") +
#   theme_classic()
```

Confidence Interval, Percentile Method Use the percentile method to find a 95% confidence interval for the mean.

```
# Percentile Method
# bootstrap_dist %>%
#   summarize(center=mean(ave),
#              lower=quantile(ave, probs=_____),
#              upper=quantile(ave, probs=_____))
```

This distribution seems to be roughly symmetric.

```
# Standard Error Method
# bootstrap_dist %>%
#   summarize(center=_____,
#             lower=_____ - _____*qnorm(_____),
#             upper=_____ + _____*qnorm(_____))
```

Confidence Interval, standard error method

LC 8.3 (Objective 1)

(LC 8.3) What condition about the bootstrap distribution must be met for us to be able to construct confidence intervals using the standard error method?

Solution:

LC 8.4 (Objective 2)

(LC 8.4) Say we wanted to construct a 68% confidence interval instead of a 95% confidence interval for μ . Describe what changes are needed to make this happen. Hint: we suggest you look at Appendix A.2 on the normal distribution.

Solution:

Documenting software

- File creation date: 2022-07-06
- R version 4.1.3 (2022-03-10)
- tidyverse package version: 1.3.1
- moderndive package version: 0.5.4