A4_109006240

Jansen

2023-12-21

Package Loading

```r
require(lubridate)
```

```
## Loading required package: lubridate

##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```r
require(gapminder)
```

```
## Loading required package: gapminder
```

```r
require(readr)
```

```
## Loading required package: readr
```

```r
require(knitr)
```

```
## Loading required package: knitr
```

```r
require(dplyr)
```

```
## Loading required package: dplyr

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
require(tidyverse)
```

```
## Loading required package: tidyverse

## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v forcats 1.0.0     v stringr 1.5.0
## v ggplot2 3.4.4     v tibble  3.2.1
## v purrr   1.0.2     v tidyr   1.3.0
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become error
```

```r
require(tidyr)
require(ggplot2)
require(broom)
```

```
## Loading required package: broom
```

```r
require(Metrics)
```

```
## Loading required package: Metrics

## Warning: package 'Metrics' was built under R version 4.3.2
```

```r
require(infer)
```

```
## Loading required package: infer

## Warning: package 'infer' was built under R version 4.3.2
```

Question 1

ATE represent the difference between those who received the rags to rich TV treatment and control in this context we can simply think if the ATE are positive then the TV treatment give positive affect, vice versa

```r
rags <- read_csv('rags.csv')
```

```
## Rows: 763 Columns: 6
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## dbl (6): mobility, condition2, rep, dem, optimism_index, sjs_index
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
subset_rags <- rags %>%
  mutate(
    treatment = if_else(condition2 == 1, "Rags to Riches", "Control"),
    optimist = if_else(optimism_index >= 3, "Optimist", "Pessimist")
  )
treatment <- subset_rags$treatment
optimist <- subset_rags$optimist
treatment
```

```
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##   [5] "Rags to Riches" "Rags to Riches" "Control"        "Control"
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optimist
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## [283] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [289] "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [295] "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [301] "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Pessimist"
## [307] "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist"
## [313] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [319] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [325] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [331] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [337] "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"
## [343] "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"
## [349] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [355] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [361] "Pessimist" "Optimist"  "Pessimist" "Optimist"  "Pessimist" "Pessimist"
## [367] "Pessimist" "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist"
## [373] "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Pessimist"
## [379] "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"
## [385] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [391] "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"
```

```
## [397] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [403] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [409] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [415] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [421] "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [427] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [433] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
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## [445] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist"
## [451] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist"
## [457] "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [463] "Optimist"  "Pessimist" "Pessimist" "Pessimist" "Optimist"  "Optimist"
## [469] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [475] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [481] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist"
## [487] "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"
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## [499] "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"
## [505] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Pessimist"
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## [523] "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist"
## [529] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
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## [541] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
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## [553] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [559] "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"
## [565] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [571] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist"
## [577] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [583] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [589] "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [595] "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Pessimist" "Optimist"
## [601] "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Pessimist"
## [607] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Pessimist" "Pessimist"
## [613] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [619] "Optimist"  "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [625] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [631] "Pessimist" "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"
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## [643] "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"
## [649] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [655] "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Pessimist"
## [661] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist"
## [667] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [673] "Pessimist" "Pessimist" "Optimist"  "Pessimist" "Pessimist" "Optimist"
## [679] "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist"
## [685] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [691] "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Pessimist" "Optimist"
## [697] "Pessimist" "Pessimist" "Optimist"  "Pessimist" "Optimist"  "Optimist"
## [703] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [709] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [715] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
```

```
## [721] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [727] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist"
## [733] "Optimist"  "Pessimist" "Pessimist" "Optimist"  "Optimist"  "Pessimist"
## [739] "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Pessimist" "Optimist"
## [745] "Optimist"  "Pessimist" "Pessimist" "Pessimist" "Pessimist" "Optimist"
## [751] "Optimist"  "Optimist"  "Optimist"  "Optimist"  "Pessimist" "Optimist"
## [757] "Optimist"  "Pessimist" "Optimist"  "Optimist"  "Optimist"  "Optimist"
## [763] "Pessimist"
```

```
rags
```

```
## # A tibble: 763 x 6
##    mobility condition2   rep   dem optimism_index sjs_index
##       <dbl>      <dbl> <dbl> <dbl>          <dbl>     <dbl>
##  1    0.292          1     0     0           4         2   
##  2    0.583          0     0     0           3.83      2.60
##  3    0.375          0     1     0           4.33      2.60
##  4    0.625          0     0     0           3.83      2.40
##  5    0.708          1     1     0           4.17      3.80
##  6    0.583          1     0     1           2.33      2.60
##  7    0.333          0     0     0           1.17      1.80
##  8    0.625          0     1     0           3.17      3.60
##  9    0.917          1     1     0           3         3   
## 10    0.583          0     1     0           3         2.60
## # i 753 more rows
```

```
subset_rags
```

```
## # A tibble: 763 x 8
##    mobility condition2   rep   dem optimism_index sjs_index treatment   optimist
##       <dbl>      <dbl> <dbl> <dbl>          <dbl>     <dbl> <chr>       <chr>   
##  1    0.292          1     0     0           4         2    Rags to Ri~ Optimist
##  2    0.583          0     0     0           3.83      2.60 Control     Optimist
##  3    0.375          0     1     0           4.33      2.60 Control     Optimist
##  4    0.625          0     0     0           3.83      2.40 Control     Optimist
##  5    0.708          1     1     0           4.17      3.80 Rags to Ri~ Optimist
##  6    0.583          1     0     1           2.33      2.60 Rags to Ri~ Pessimi~
##  7    0.333          0     0     0           1.17      1.80 Control     Pessimi~
##  8    0.625          0     1     0           3.17      3.60 Control     Optimist
##  9    0.917          1     1     0           3         3    Rags to Ri~ Optimist
## 10    0.583          0     1     0           3         2.60 Control     Optimist
## # i 753 more rows
```

```
mobility_diff <- subset_rags %>%
  group_by(treatment) %>%
  summarize(mean_mobility = mean(mobility)) %>%
  pivot_wider(names_from = treatment, values_from = mean_mobility) %>%
  mutate(ATE = `Rags to Riches` - Control)
mobility_diff
```

```
## # A tibble: 1 x 3
##   Control `Rags to Riches`    ATE
##     <dbl>            <dbl>  <dbl>
## 1   0.527            0.589 0.0615
```

Question 2

there are no zero in the CI we can see it on the graph that within the 2 line there are no zero, which means that the treatment do have an impact to the outcome

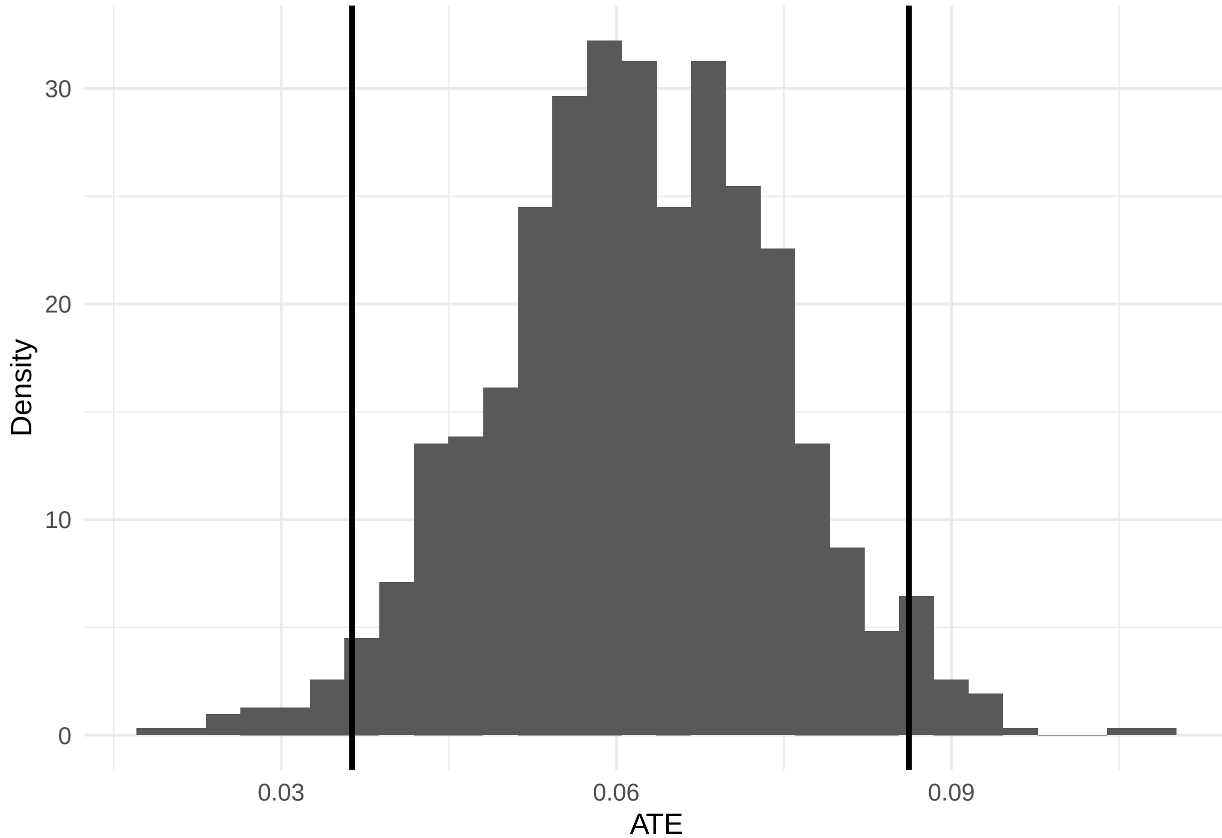
```
library(infer)
set.seed(2023)

ate_boots <- subset_rags %>%
  specify(response = mobility, explanatory = treatment) %>%
  generate(reps = 1000, type = "bootstrap") %>%
  calculate(stat = "diff in means", order = c("Rags to Riches", "Control"))


ate_ci_95 <- ate_boots %>%
  get_confidence_interval(level = 0.95, type = "percentile")

ate_ci_95
```

```
## # A tibble: 1 x 2
##   lower_ci upper_ci
##      <dbl>    <dbl>
## 1   0.0363   0.0862
```

```
ggplot(data = ate_boots, aes(x = stat)) +
  geom_histogram(aes(y = ..density..)) +
  geom_vline(xintercept = unlist(ate_ci_95), linewidth = 1) +
  labs(x = "ATE", y = "Density") +
  theme_minimal()
```

```
## Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.
## i Please use `after_stat(density)` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Question 3

Explain how to interpret 95% confidence intervals in terms of repeated sampling. = if we repeat the sampling again again and again around 95% of that interval is true

Is it possible to produce a 100% confidence interval in this setting? If so, what is it and is it useful? = i think its possible to produce a 100% CI but i don't think it will be usefull

Question 4

so in this part we bassically wanted to see how the treatment affect 2 kind of people, thseo that are optimist and those that are pessimist and the ate_diff just show the difference between the affect that pes and opt get and we can see in the tibble that the optimistic group have a higher ATE which means those that are optimist gain more benefit from the TV treatment

```
ATE_optimist <- subset_rags %>%
  filter(optimist == "Optimist") %>%
  group_by(treatment) %>%
  summarize(mean_mobility = mean(mobility)) %>%
  pivot_wider(names_from = treatment, values_from = mean_mobility) %>%
  mutate(ATE_Opt = `Rags to Riches` - Control) %>%
  pull(ATE_Opt)

ATE_pessimist <- subset_rags %>%
```

```r
  filter(optimist == "Pessimist") %>%
  group_by(treatment) %>%
  summarize(mean_mobility = mean(mobility)) %>%
  pivot_wider(names_from = treatment, values_from = mean_mobility) %>%
  mutate(ATE_Pes = Control - `Rags to Riches`) %>%
  pull(ATE_Pes)
ATE_diff <- ATE_optimist - ATE_pessimist

ate_optimist <- tibble(
  ATE_Opt = ATE_optimist,
  ATE_Pes = ATE_pessimist,
  ATE_Diff = ATE_diff
)

ate_optimist
```

```
## # A tibble: 1 x 3
##   ATE_Opt ATE_Pes ATE_Diff
##     <dbl>   <dbl>    <dbl>
## 1  0.0870  0.0240   0.0630
```

Question 5

if we see the plot there are no 0 in the confidence interval so we can confidently conclude that there is a statistically significant difference in the treatment effects between Optimists and Pessimists. and the treatment does have impact

```r
set.seed(2023)

ate_optimist_boots <- tibble(
  replicate = numeric(),
  ATE_Opt = numeric(),
  ATE_Pes = numeric(),
  ATE_Diff = numeric()
)

bootstrap_replicates <- subset_rags %>%
  rep_slice_sample(prop = 1, reps = 1000, replace = TRUE) %>%
  group_by(replicate)

for (i in 1:1000) {
  ATE_optimist <- bootstrap_replicates %>%
    filter(optimist == "Optimist") %>%
    filter(replicate == i) %>%
    group_by(treatment) %>%
    summarize(mean_mobility = mean(mobility)) %>%
    pivot_wider(names_from = treatment, values_from = mean_mobility) %>%
    mutate(ATE_Opt = `Rags to Riches` - Control) %>%
    pull(ATE_Opt)

  ATE_pessimist <- bootstrap_replicates %>%
    filter(optimist == "Pessimist") %>%
```

```r
    filter(replicate == i) %>%
    group_by(treatment) %>%
    summarize(mean_mobility = mean(mobility)) %>%
    pivot_wider(names_from = treatment, values_from = mean_mobility) %>%
    mutate(ATE_Pes = Control - `Rags to Riches`) %>%
    pull(ATE_Pes)
  ATE_diff <- ATE_optimist - ATE_pessimist

  temp <- tibble(
    replicate = i,
    ATE_Opt = ATE_optimist,
    ATE_Pes = ATE_pessimist,
    ATE_Diff = ATE_diff
  )
  ate_optimist_boots <- bind_rows(ate_optimist_boots, temp)
}
bootstrap_replicates
```

```
## # A tibble: 763,000 x 9
## # Groups:   replicate [1,000]
##    replicate mobility condition2   rep   dem optimism_index sjs_index treatment
##        <int>    <dbl>      <dbl> <dbl> <dbl>          <dbl>     <dbl> <chr>
##  1         1   0.792           1     0     0           2         2.20 Rags to R~
##  2         1   0.5             0     0     1           1.83      2.20 Control
##  3         1   0.25            1     0     1           2.83      1.80 Rags to R~
##  4         1   0.0417          1     0     1           1.67      1.80 Rags to R~
##  5         1   0.458           1     0     1           3.17      2.20 Rags to R~
##  6         1   0.5             0     0     1           3         2.40 Control
##  7         1   0.458           0     0     1           3.17      2.80 Control
##  8         1   0.542           0     0     0           2         1.80 Control
##  9         1   0.458           1     0     0           3         2.80 Rags to R~
## 10         1   0.542           0     0     0           2.5       2.20 Control
## # i 762,990 more rows
## # i 1 more variable: optimist <chr>
```

```r
ate_optimist_boots
```

```
## # A tibble: 1,000 x 4
##    replicate ATE_Opt  ATE_Pes ATE_Diff
##        <dbl>   <dbl>    <dbl>    <dbl>
##  1         1  0.0881  0.0687    0.0194
##  2         2  0.0663  0.0321    0.0343
##  3         3  0.108  -0.00589   0.114
##  4         4  0.107   0.0595    0.0474
##  5         5  0.103   0.0436    0.0592
##  6         6  0.0946  0.0322    0.0624
##  7         7  0.103   0.0826    0.0206
##  8         8  0.0850  0.00103   0.0840
##  9         9  0.0914  0.0462    0.0452
## 10        10  0.0854 -0.0108    0.0962
## # i 990 more rows
```

```r
ate_optimist_ci_95 <- ate_optimist_boots %>%
  get_confidence_interval(level = 0.95, type = "percentile")
ate_optimist_ci_95
```

```
## # A tibble: 1 x 2
##   lower_ci upper_ci
##      <dbl>    <dbl>
## 1  0.00948    0.119
```

```r
ggplot(data = ate_boots, aes(x = stat)) +
  geom_histogram(aes(y = ..density..)) +
  geom_vline(xintercept = unlist(ate_optimist_ci_95), linewidth = 1, color = "red") +
  labs(x = "ATE", y = "Density") +
  theme_minimal()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```