Appendix E: Trial Study W241 Project

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1. Setup

```
library(data.table)
library(stargazer)
library(dplyr)
library(lmtest)
library(sandwich)
```

2. ATE

```
din <- fread('./Data/Final Project v1 - Sheet1.csv', header = TRUE)
d <- din[, treat:= as.numeric(Treatment == "Gaming")]
d <- d[0:48]
nrow(d)
```

```
## [1] 48
```

```
head(d)
```

```
##    Special_comments                     Email v_lt_8 v_lt_6 v_lt_4 v_lt_2
## 1:                      anirudh.marg@gmail.com      0      0      0      1
## 2:                         kp.kriish@gmail.com      0      0      1      0
## 3:                     tanaybiradar24@gmail.com      0      0      0      1
## 4:                     bansal.devansh@gmail.com      0      0      0      1
## 5:                   rishi.pasumarthi@gmail.com      0      1      0      0
## 6:                         starrye22@gmail.com      0      0      0      1
##    r_lt_8 r_lt_6 r_lt_4 r_lt_2 m_lt_8 m_lt_6 m_lt_4 m_lt_2
## 1:      0      0      1      0      0      0      0      1
## 2:      0      1      0      0      0      1      0      0
## 3:      0      1      0      0      0      1      0      0
## 4:      0      0      1      0      1      0      0      0
## 5:      0      1      0      0      0      0      0      1
## 6:      0      1      0      0      0      0      1      0
##    took_afternoon_test owns_gaming_console Male Grade Treatment Compliance
## 1:                   1                    1    1    10   Reading          1
## 2:                   1                    1    1    10    Gaming          1
## 3:                   0                    0    1    10     Music          1
## 4:                   1                    1    1    10   Reading          1
## 5:                   0                    1    1    10    Gaming          1
## 6:                   0                    0    0     9   Reading          1
##    Pre_score Post_score Total_score Score_diff treat
```

```
## 1:        41         43          84          2     0
## 2:        38         43          81          5     1
## 3:        34         41          75          7     0
## 4:        34         39          73          5     0
## 5:        27         42          69         15     1
## 6:        26         41          67         15     0
```

```
tg = d[Treatment == "Gaming"][, Score_diff]
tg
```

```
##  [1]   5  15  -4  -5   5   4  10   0  13   8  15   8  10 -23   8   7 -15
```

```
treat_avg = mean (tg)
treat_avg
```

```
## [1] 3.588235
```

```
cg = d[Treatment != "Gaming"][, Score_diff]
cg
```

```
##  [1]   2   7   5  15   3   9   9  15  17   5   1  -3  10   4  14  -3   0
## [18]  10   4  14  11   5  -2  -3   8   6  12  -4 -12 -16  -8
```

```
control_avg = mean (cg)
control_avg
```

```
## [1] 4.354839
```

```
ATE_pilot = treat_avg - control_avg
ATE_pilot
```

```
## [1] -0.7666034
```

Taking only good data into account

```
d_good = d[d$Compliance == 1 & d$Special_comments == ""]
nrow(d_good)
```

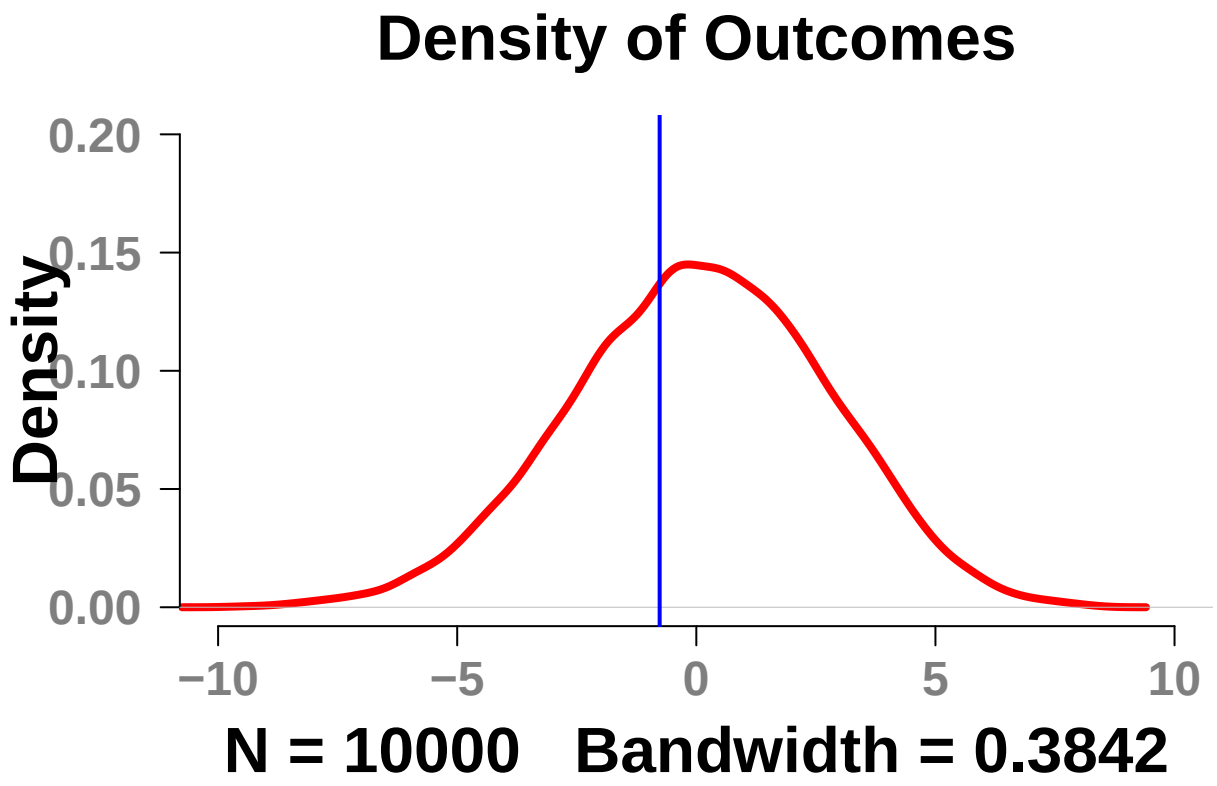
```
## [1] 35
```

```
ATE_good = mean(d_good[Treatment == "Gaming"][, Score_diff]) - mean(d_good[Treatment != "Gaming"][, Sco
ATE_good
```

```
## [1] 0.1413043
```

```r
#Randomization inference functions from PS2
est_ate <- function(outcome, treat) {
  mean(outcome[treat==1]) - mean(outcome[treat==0])
}

outcome = d[,Score_diff]
treat = d[,treat]

outcome_good = d_good[,Score_diff]
treat_good = d_good[,treat]

observed_ate = est_ate(outcome, treat )
observed_ate_good = est_ate(outcome_good, treat_good)
```

```r
rand_experiment <- function(potential_outcome, treat_vec) {
  po_control <- potential_outcome
  #Looking for zero effect
  po_treatment <- po_control
  treatment <- sample(treat_vec)
  outcomes <- po_treatment * treatment + po_control * (1 - treatment)
  ate <- est_ate(outcomes, treatment)
  return(ate)
}

dn_under_sharp_null <- replicate(10000, rand_experiment(outcome, treat))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate, col = "blue")
```



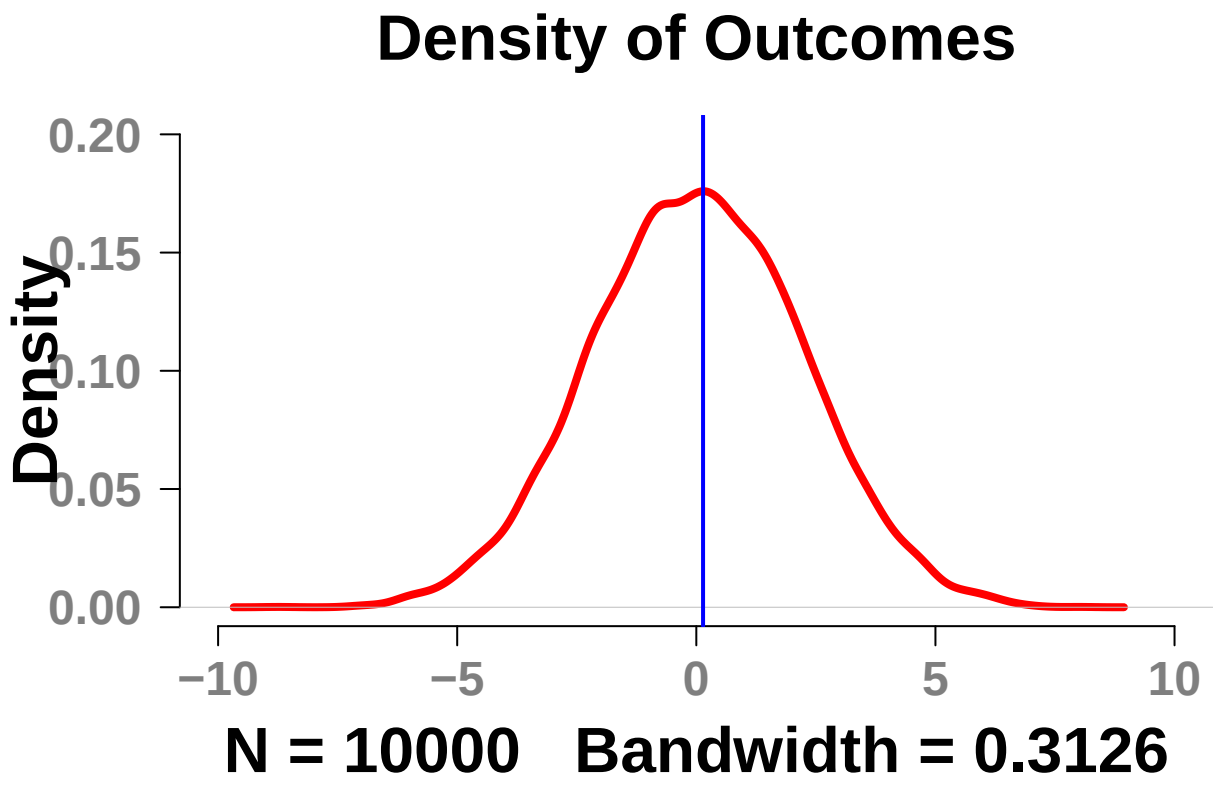

```
p_value <- mean(observed_ate > dn_under_sharp_null)
p_value
```

```
## [1] 0.3657
```

```
sd(dn_under_sharp_null)
```

```
## [1] 2.693704
```

```
dn_under_sharp_null_good <- replicate(10000, rand_experiment(outcome_good, treat_good))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null_good),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate_good, col = "blue")
```




```
p_value_good <- mean(observed_ate_good > dn_under_sharp_null_good)
p_value_good
```

```
## [1] 0.5094
```

```
sd(dn_under_sharp_null_good)
```

```
## [1] 2.191606
```

CATE

Grades

```
nrow(d[d$Grade == 8])
```

```
## [1] 4
```

```
nrow(d[d$Grade == 9])
```

```
## [1] 3
```

```r
nrow(d[d$Grade == 10])
```

```
## [1] 34
```

```r
nrow(d[d$Grade == 11])
```

```
## [1] 7
```

Grade with all values

```r
get_cate_grade <-function(d,val) {
  CATE = mean(d[Treatment == "Gaming" & Grade == val][, Score_diff]) - mean(d[Treatment != "Gaming" & Gr
  return(CATE)
}
get_cate_grade(d,9)
```

```
## [1] NaN
```

```r
get_cate_grade(d,10)
```

```
## [1] -2.312253
```

```r
get_cate_grade(d,11)
```

```
## [1] 0.08333333
```

```r
get_cate_grade(d,12)
```

```
## [1] NaN
```

Grade with good values only

```r
get_cate_grade <-function(d,val) {
  CATE = mean(d[Treatment == "Gaming" & Grade == val][, Score_diff]) - mean(d[Treatment != "Gaming" & Gr
  return(CATE)
}
get_cate_grade(d_good,9)
```

```
## [1] NaN
```

```r
get_cate_grade(d_good,10)
```

```
## [1] -0.4375
```

```
get_cate_grade(d_good,11)
```

```
## [1] -1.5
```

```
get_cate_grade(d_good,12)
```

```
## [1] NaN
```

RI only for grade 10

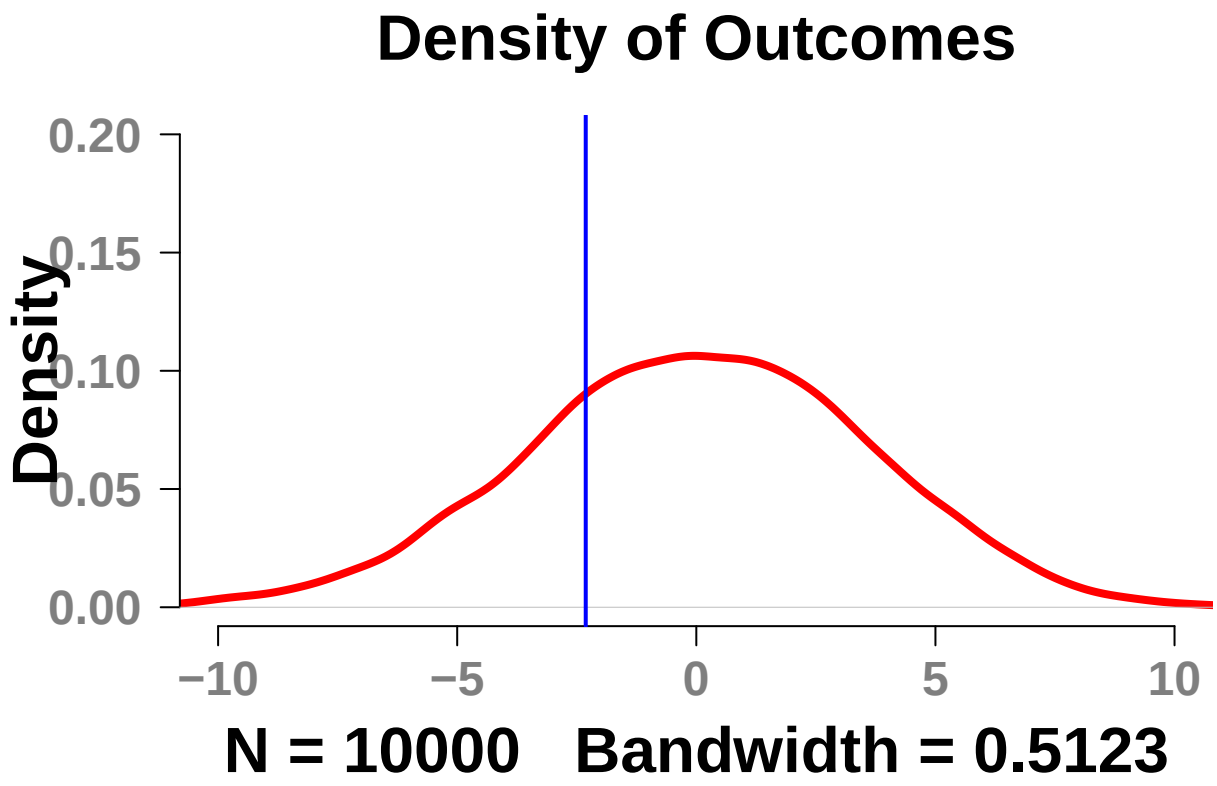
```
d_grad10 <- d[d$Grade == 10]
nrow(d_grad10)
```

```
## [1] 34
```

```
outcome = d_grad10[,Score_diff]
treat = d_grad10[,treat]
observed_ate = est_ate(outcome, treat)
observed_ate
```

```
## [1] -2.312253
```

```
dn_under_sharp_null <- replicate(10000, rand_experiment(outcome, treat))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate, col = "blue")
```




```
p_value <- mean(observed_ate > dn_under_sharp_null)
p_value
```

```
## [1] 0.2523
```

```
sd(dn_under_sharp_null)
```

```
## [1] 3.59175
```

Took afternoon test

```
nrow(d[took_afternoon_test == 1])
```

```
## [1] 23
```

```
get_cate_noon_test <-function(d,val) {
  CATE = mean(d[Treatment == "Gaming" & took_afternoon_test == val][, Score_diff]) - mean(d[Treatment !=
  return(CATE)
}
get_cate_noon_test(d,1)
```

```
## [1] 1.04902
```

```
get_cate_noon_test(d_good,1)
```

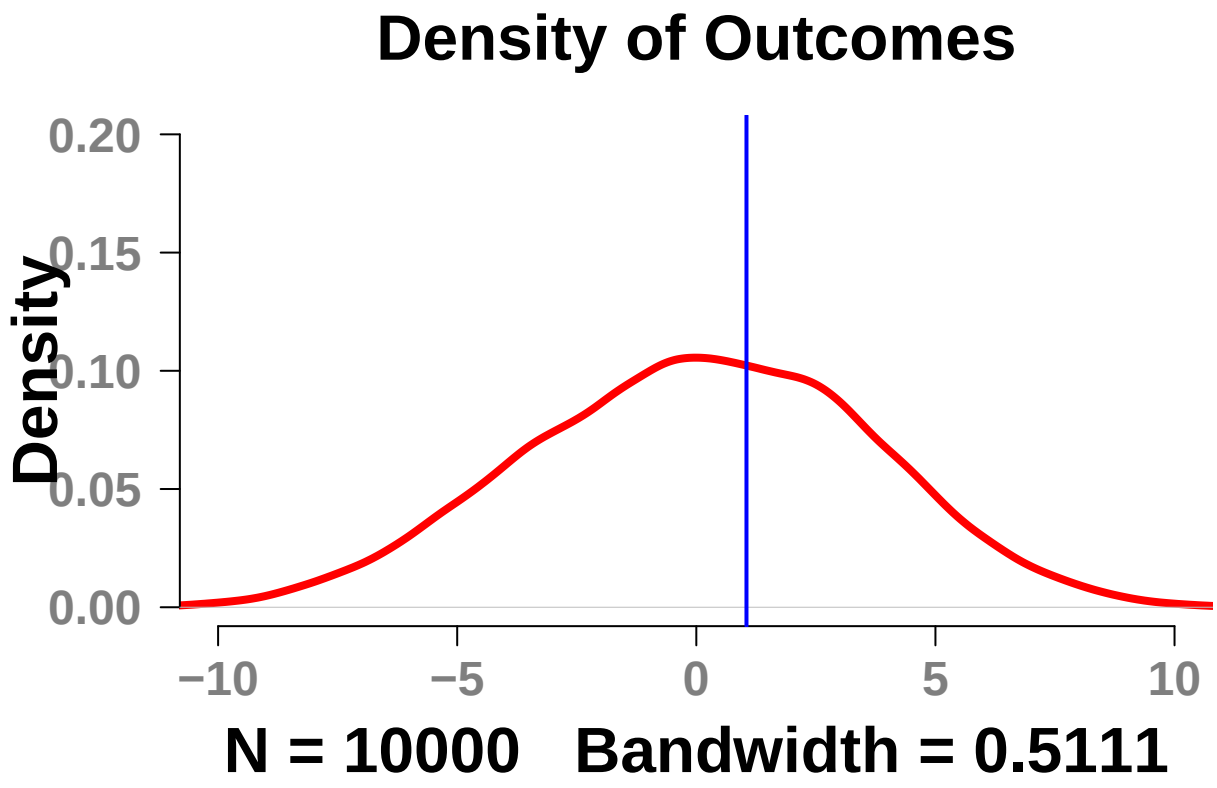
```
## [1] -2.166667
```

RI for noon test

```
d_noon_test <- d[d$took_afternoon_test == 1]
nrow(d_noon_test)
```

```
## [1] 23
```

```
outcome = d_noon_test[,Score_diff]
treat = d_noon_test[,treat]
observed_ate = est_ate(outcome, treat)

dn_under_sharp_null <- replicate(10000, rand_experiment(outcome, treat))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate, col = "blue")
```



```
p_value <- mean(observed_ate > dn_under_sharp_null)
p_value
```

```
## [1] 0.5817
```

```
sd(dn_under_sharp_null)
```

```
## [1] 3.582828
```

Has Gaming Console

```
nrow(d[owns_gaming_console == 1])
```

```
## [1] 28
```

```
get_cate_owns_gm_cons <-function(d,val) {
  CATE = mean(d[Treatment == "Gaming" & owns_gaming_console == val][, Score_diff]) - mean(d[Treatment !=
  return(CATE)
}
get_cate_owns_gm_cons(d,1)
```

```
## [1] -0.5561497
```

```
get_cate_owns_gm_cons(d_good,1)
```

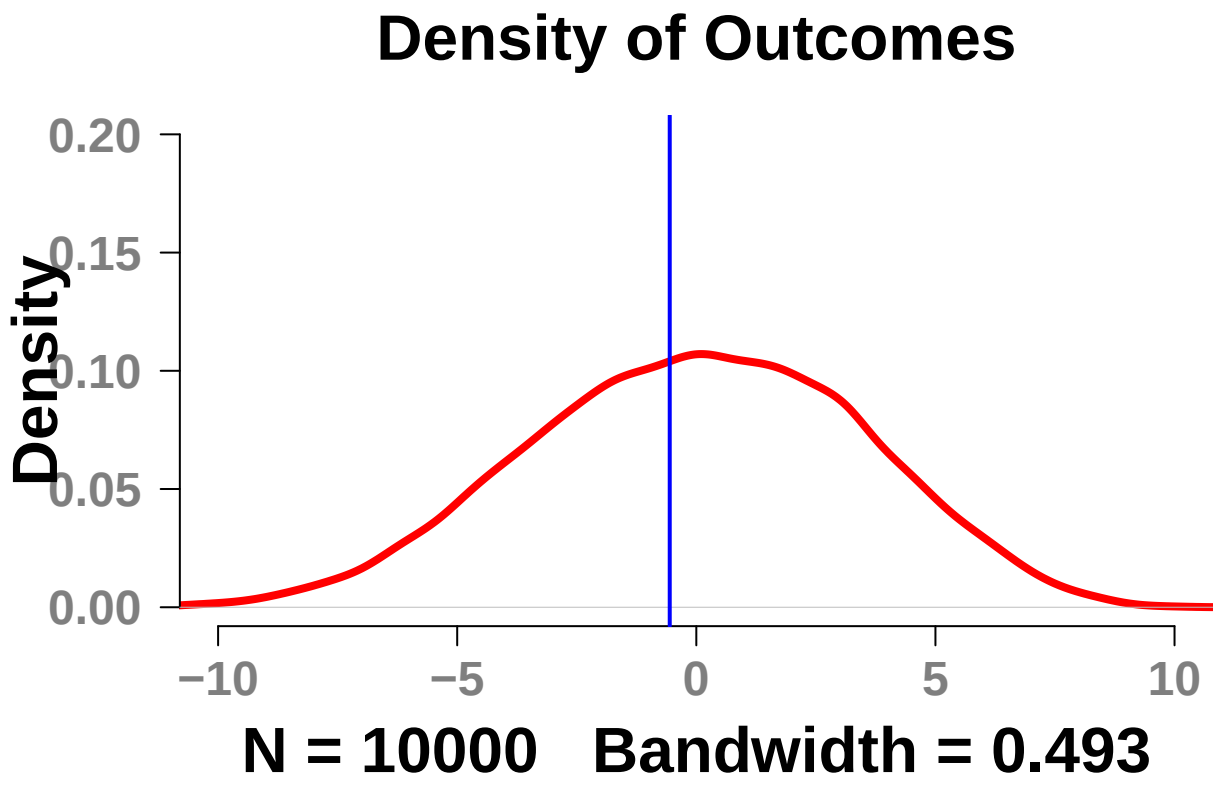
```
## [1] -0.6590909
```

RI for Gaming Console

```
d_owns_gc <- d[d$owns_gaming_console == 1]
nrow(d_owns_gc)
```

```
## [1] 28
```

```
outcome = d_owns_gc[,Score_diff]
treat = d_owns_gc[,treat]
observed_ate = est_ate(outcome, treat)

dn_under_sharp_null <- replicate(10000, rand_experiment(outcome, treat))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate, col = "blue")
```




```
p_value <- mean(observed_ate > dn_under_sharp_null)
p_value
```

```
## [1] 0.424
```

```
sd(dn_under_sharp_null)
```

```
## [1] 3.456253
```

Male

```
nrow(d[Male == 1])
```

```
## [1] 40
```

```
get_cate_male <-function(d,val) {
  CATE = mean(d[Treatment == "Gaming" & Male == val][, Score_diff]) - mean(d[Treatment != "Gaming" & Ma
  return(CATE)
}
get_cate_male(d,1)
```

```
## [1] 0.8958333
```

```
get_cate_male(d_good,1)
```

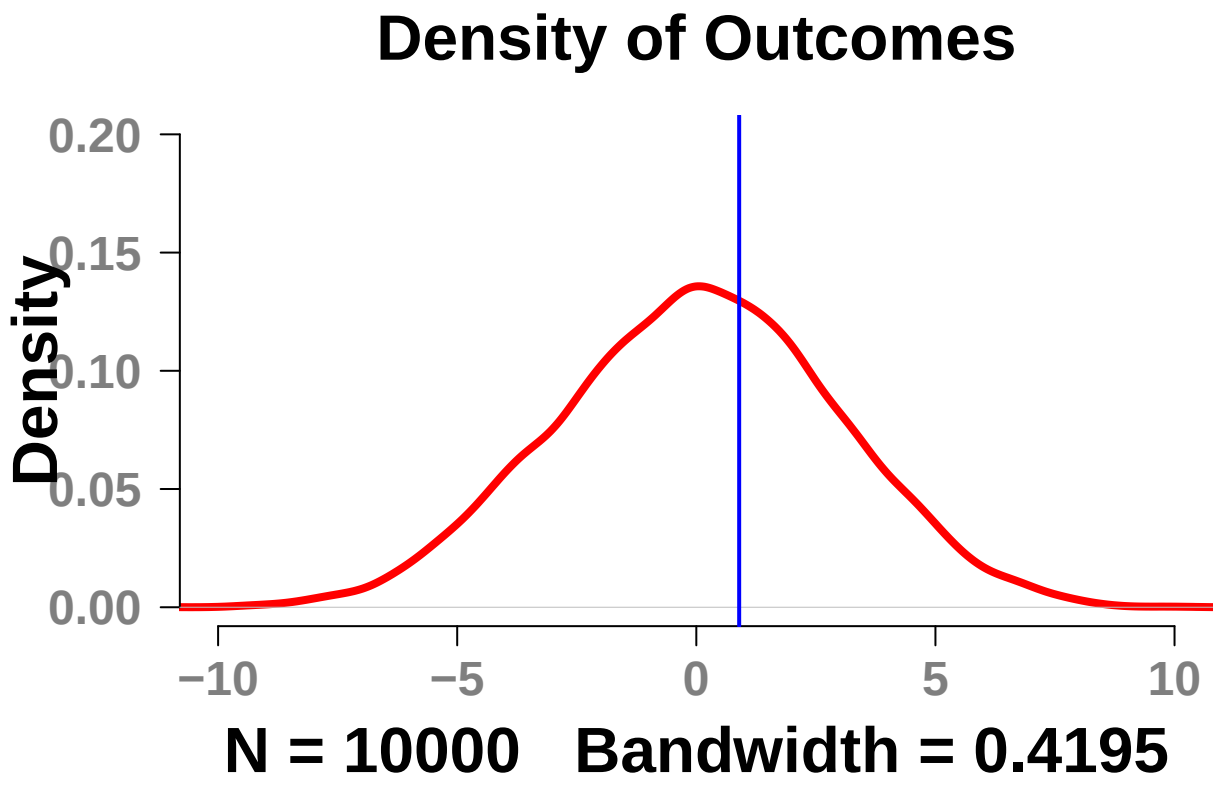
```
## [1] 1.550505
```

RI for Gaming Console

```
d_male <- d[d$Male == 1]
nrow(d_male)
```

```
## [1] 40
```

```
outcome = d_male[,Score_diff]
treat = d_male[,treat]
observed_ate = est_ate(outcome, treat)

dn_under_sharp_null <- replicate(10000, rand_experiment(outcome, treat))
source("http://ischool.berkeley.edu/~d.alex.hughes/code/pubPlot.R")
plot(density(dn_under_sharp_null),
     main = "Density of Outcomes",
     lwd = 4, col="red",
     ylim=c(0,0.2),
     xlim=c(-10,10))
abline(v = observed_ate, col = "blue")
```




```
p_value <- mean(observed_ate > dn_under_sharp_null)
p_value
```

```
## [1] 0.6043
```

```
sd(dn_under_sharp_null)
```

```
## [1] 2.940867
```