R Coding Demonstration Week 10: Effect of Increasing the Minimum Wage

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Introduction

- Does the increasing the minimum wage affect employment? Classical economics says yes, but that's in theory.
- Compare states that have higher minimum wages to those that don't? Possible confounding!
- Compare a state that changed its minimum wage to a similar state that did not $\rightsquigarrow$ differences-in-differences design.
- Today: compare New Jersey (increased min wage) to Pennsylvania (kept min wage the same).
    - In 1992, NJ increased minimum wage from \$4.25 to \$5.05.
    - PA stayed at \$4.25.

Data

```
minwage <- read.csv("data/minwage.csv")
```

Name	Description
`chain`	name of fast food restaurant chain
`state`	location of restaurant (NJ, PA)
`wage_before`	average wage before minimum wage increase
`wage_after`	average wage after minimum wage increase
`fulltime_before`	proportion of full-time employees before increase
`fulltime_after`	proportion of full-time employees after increase

Question 1

Calculate the average wages in New Jersey before the increase. Use the estimated standard deviation of the before wages in NJ to estimate the standard error of the average wages. Interpret what this standard error means in this context.

Answer 1

```
nj_data <- subset(minwage, state == "NJ")
N_nj <- nrow(nj_data)

mean(nj_data$wage_before)
```

```
## [1] 4.61
```

```
## standard deviation
sd(nj_data$wage_before)
```

```
## [1] 0.343
```

```
## standard error
sd(nj_data$wage_before) / sqrt(N_nj)
```

```
## [1] 0.0201
```

Question 2

Calculate the average wages in Pennsylvania before the increase. Use the estimated standard deviation of the before wages in PA to estimate the standard error of the average wages. Interpret what this standard error means in this context.

Answer 2

```r
pa_data <- subset(minwage, state == "PA")
N_pa <- nrow(pa_data)

mean(pa_data$wage_before)
```

```
## [1] 4.65
```

```r
## standard deviation
sd(pa_data$wage_before)
```

```
## [1] 0.358
```

```r
## standard error
sd(pa_data$wage_before) / sqrt(N_pa)
```

```
## [1] 0.0438
```

Question 3

Calculate the difference in average wages between NJ and PA before the change. Calculate the standard error of this difference. Is the observed difference big relative to the standard error?

Answer 3

```
nj_pa_wagediff <- mean(nj_data$wage_before) - mean(pa_data$wage_before)
nj_pa_wagediff
```

```
## [1] -0.0414
```

```
nj_se <- sd(nj_data$wage_before) / sqrt(N_nj)
pa_se <- sd(pa_data$wage_before) / sqrt(N_pa)

se_wagediff <- sqrt(nj_se ^ 2 + pa_se ^ 2)
se_wagediff
```

```
## [1] 0.0482
```

Question 4

Calculate the difference in average full-time employees between NJ and PA before the change (`fulltime_before`). Calculate the standard error of this difference. Is the observed difference big relative to the standard error?

Answer 4

```
ft_before <- mean(nj_data$fulltime_before) -
  mean(pa_data$fulltime_before)
ft_before
```

```
## [1] -0.0134
```

```
nj_ft_before_se <- sd(nj_data$fulltime_before) / sqrt(N_nj)
pa_ft_before_se <- sd(pa_data$fulltime_before) / sqrt(N_pa)

se_ft_before <- sqrt(nj_ft_before_se ^ 2 + pa_ft_before_se ^ 2)
se_ft_before
```

```
## [1] 0.0323
```

Question 5

Calculate the difference in average full-time employment between NJ and PA **after** the change (`fulltime_after`). Calculate the standard error of this difference and use it to form a 92% confidence interval.

Answer 5

```
ft_after <- mean(nj_data$fulltime_after) - mean(pa_data$fulltime_after)
ft_after
```

```
## [1] 0.0481
```

```
nj_ft_after_se <- sd(nj_data$fulltime_after) / sqrt(N_nj)
pa_ft_after_se <- sd(pa_data$fulltime_after) / sqrt(N_pa)

se_ft_after <- sqrt(nj_ft_after_se ^ 2 + pa_ft_after_se ^ 2)
se_ft_after
```

```
## [1] 0.0336
```

```
z_92 <- qnorm(0.04, lower.tail = FALSE)

## 92% CI c(lower, upper)
c(
  ft_after - z_92 * se_ft_after,
  ft_after + z_92 * se_ft_after
)
```

```
## [1] -0.0107  0.1069
```

Question 6

Calculate the changes in full-time employment for each restaurant before and after the wage increase. Use these to take the difference in these differences between NJ and PA to obtain a differences-in-differences estimate of the causal effect of increasing the minimum wage. Use the standard deviation of the full-time employment changes to calculate a 95% confidence interval for the estimate.

Answer 6

```
nj_data$fulltime_diff <- nj_data$fulltime_after -
  nj_data$fulltime_before

pa_data$fulltime_diff <- pa_data$fulltime_after -
  pa_data$fulltime_before

did_est <- mean(nj_data$fulltime_diff) - mean(pa_data$fulltime_diff)
did_est
```

```
## [1] 0.0616
```

```
did_nj_se <- sd(nj_data$fulltime_diff) / sqrt(N_nj)
did_pa_se <- sd(pa_data$fulltime_diff) / sqrt(N_pa)
did_se <- sqrt(did_nj_se ^ 2 + did_pa_se ^ 2)
did_se
```

```
## [1] 0.0455
```

```
c(did_est - 1.96 * did_se, did_est + 1.96 * did_se)
```

```
## [1] -0.0276  0.1508
```

Question 7

Different fast food chains might have different costs and if those vary by state, we might be worried that this difference might create confounding. Let's do statistical control by estimating the NJ/PA difference in average full-time employment between after the change for two chains: Burger King and Wendy's. Calculate 95% confidence intervals for both. Which is wider and why?

Answer 7

```
bk_nj <- subset(nj_data, chain == "burgerking")
wendys_nj <- subset(nj_data, chain == "wendys")
bk_pa <- subset(pa_data, chain == "burgerking")
wendys_pa <- subset(pa_data, chain == "wendys")

bk_diff <- mean(bk_nj$fulltime_after) - mean(bk_pa$fulltime_after)
bk_se <- sqrt((sd(bk_nj$fulltime_after) / sqrt(nrow(bk_nj))) ^ 2 +
                (sd(bk_pa$fulltime_after) / sqrt(nrow(bk_pa))) ^ 2)
c(bk_diff - 1.96 * bk_se, bk_diff + 1.96 * bk_se)
```

```
## [1] -0.0666  0.1395
```

```
wendys_diff <- mean(wendys_nj$fulltime_after) - mean(wendys_pa$fulltime_afte
wendys_se <- sqrt((sd(wendys_nj$fulltime_after) / sqrt(nrow(wendys_nj))) ^ 
                (sd(wendys_pa$fulltime_after) / sqrt(nrow(wendys_pa))) ^ 2)
c(wendys_diff - 1.96 * wendys_se, wendys_diff + 1.96 * wendys_se)
```

```
## [1] -0.194  0.218
```