Ch 16 the effects

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How Does It Work?

1. 1. You observe the number of vacations taken by Zac and Skylar in 2012, 2013, and 2014. In those years, Zac took 3, 7, and 5 vacations, respectively. Skylar took 2, 6, and 10.

a. Variation between Zac and Skylar

Mean Zach: (3+7+5)/3 = 5 Mean Skylar: (2+6+10)/3= 6

The between variation is 1

b. within variatin for Zac 2012 3-5=-2 2013 7-5 =2 2014 5-5 =0

c. It will be closer to 2 because Skylar took more vacations and was made happier on average per vacation then Zac was.

within variation for Skylar 2012 2-6=-4 2013 6-6=0 2014 10-6= 4

2. 2. You are interested in the effect of cultural events on the levels of trust in a city. Perhaps big events like concerts bring people together and they can trust each other more. You plan to look at the relationship between trust and number of events in a given year, with fixed effects for city. Draw a causal diagram for this research question with at least four back door paths. Which paths will be closed by fixed effects, and which will remain open?

```
library(broom)
library(tibble)
library(ggdag)
```

```
##
## Attaching package: 'ggdag'
```

```
## The following object is masked from 'package:stats':
##
##     filter
```

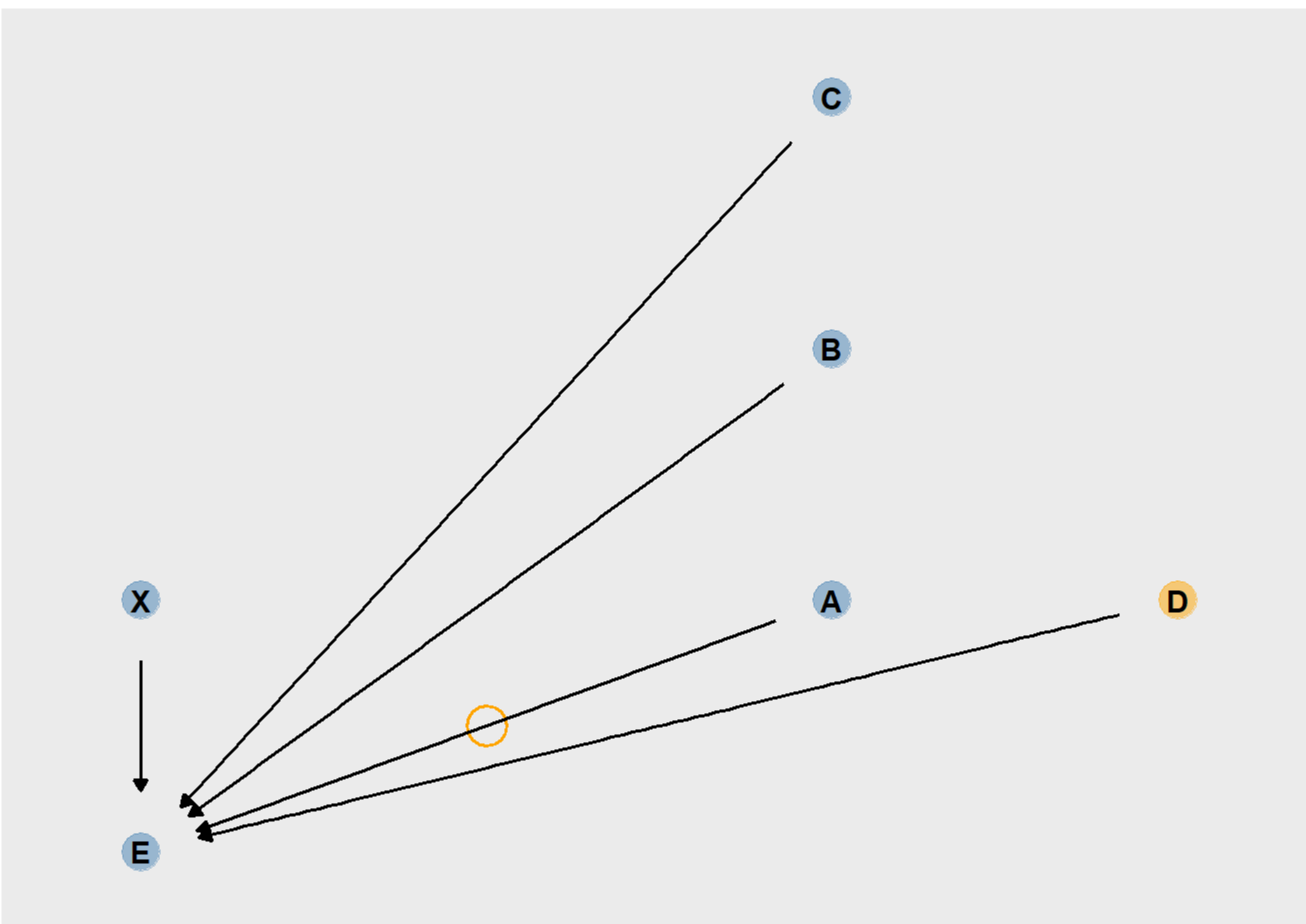
```
library(ggplot2)
library(dagitty)
```

E = Trust in cities X= Number of Cultural Events A = Georgraphy of City B = Socioeconomic Status C = Racial demographics D = Weather

```r
library(ggdag)
dag_coords <-
 tibble(name = c("E", "X", "A", "B", "C", "D"),
 x = c(1, 1, 3, 3, 3, 4),
 y = c(1, 3, 3, 5, 7, 3))
dagify(E ~ X,
       E ~ A,
       E ~ B,
       E ~ C,
       E ~ D,

 coords = dag_coords) %>%

 ggplot(aes(x = x, y = y, xend = xend, yend = yend)) +
 geom_dag_point(aes(color = name == "D"),
 alpha = 1/2, size = 6.5, show.legend = F) +
 geom_point(x = 2, y = 2,
 size = 6.5, shape = 1, stroke = 1, color = "orange") +
 geom_dag_text(color = "black") +
 geom_dag_edges() +
 scale_color_manual(values = c("steelblue", "orange")) +
 scale_x_continuous(NULL, breaks = NULL, expand = c(.1, .1)) +
 scale_y_continuous(NULL, breaks = NULL, expand = c(.1, .1))
```



All of these variables impact the level of trust in a city. If you have a fixed effect where you just look at one city over time it controls for the other variables because the other factors stay constant in that one city.

3.

a. Within
b. Between
c. Between
d. Between
e. Within
f. Between

4. Why does the process of taking each observation relative to its individual-level mean have the effect of "controlling for individual"?

This process isolates other variables that could be impacting the outcome variable between different individuals. The process is "controlling for individual" because it isolates individual differences by selecting only one individual.

How is it Performed?

1. 1. You are interested in the effect of cultural events on the levels of trust in a city. You run a regression of trust levels (on a 0-100 scale) on the number of cultural events with city fixed effects and get a coefficient on cultural events of 3.6. Assume that there are still some back doors open, so do not interpret the result causally. Interpret the 3.6, explaining it in an English sentence.

This coefficient means that there is an association of 3.6 points of higher trust levels per additional cultural event in this specific city.

2. 2. You are interested in the effect of cultural events on the levels of trust in a city. You run a regression of trust levels (on a 0-100 scale) on the number of cultural events with city and year fixed effects and get a coefficient on cultural events of 2.4. Assume that there are still some back doors open, so do not interpret the result causally. Interpret the 2.4, explaining it in an English sentence.

This coefficient means that there is an association of 2.4 points of higher trust levels per additional cultural event in this specific city.

3. Two-way fixed effects with terms for both individual and time are often referred to as "controlling for individual and time effects". Why might a researcher want to do this rather than just taking individual fixed effects and adding a linear/polynomial/etc. term for time?

The example given in the book is that two way fixed effects makes sense if there's variation in the individual over time. For example if someone is growting it makes sense to lookat the viartion within the indiviudal as well as the variation within different years.

4. option b is the correct answer

Coding Section

1.

```
library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse 1.3.2 ──
## ✓ tidyr   1.2.1      ✓ dplyr   1.0.10
## ✓ readr   2.1.3      ✓ stringr 1.5.0
## ✓ purrr   0.3.5      ✓ forcats 0.5.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✗ dplyr::filter() masks ggdag::filter(), stats::filter()
## ✗ dplyr::lag()    masks stats::lag()
```

```
mp <- read_csv('https://raw.githubusercontent.com/NickCH-K/TheEffectAssignments/main/mathpnl.cs
v') %>%
  select(distid, year, math4, expp, lunch)
```

```
## Rows: 3850 Columns: 52
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (52): distid, intid, lunch, enrol, ptr, found, expp, revpp, avgsal, drop...
##
## 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.
```

2.

```
# N:
length(unique(mp$distid))
```

```
## [1] 550
```

```
# T:
length(unique(mp$year))
```

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

3.

It is important to have a balanced panel because otherwise observations are missing.

```
mp %>%
  select(distid, year) %>%
  unique() %>%
  pull(year) %>%
  table()
```

```
## .
## 1992 1993 1994 1995 1996 1997 1998
##  550  550  550  550  550  550  550
```

4.

Run a regression

```
m1 <- lm(math4 ~ expp + lunch, data = mp)
```

5.

mutuate creates new variables, this is essentially subtracting the individual mean from the within variation predictor

```
mp <- mp %>%
  group_by(distid) %>%
  mutate(math4_demean = math4 - mean(math4),
         expp_demean = expp - mean(expp),
         lunch_demean = lunch - mean(lunch))
m2 <- lm(math4_demean ~ expp_demean + lunch_demean, data = mp)
```

6.

```
m3 <- lm(math4 ~ expp + lunch + factor(distid), data = mp %>% slice(1:500))
library(car)
```

```
## Warning: package 'car' was built under R version 4.2.3
```

```
## Loading required package: carData
```

```
## Warning: package 'carData' was built under R version 4.2.3
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
## The following object is masked from 'package:purrr':
##
##     some
```

```
linearHypothesis(m3,matchCoefs(m3,'distid'))
```

```
## Linear hypothesis test
##
## Hypothesis:
## factor(distid)2010 = 0
## factor(distid)2020 = 0
## factor(distid)2070 = 0
## factor(distid)2080 = 0
## factor(distid)3000 = 0
## factor(distid)3010 = 0
## factor(distid)3020 = 0
## factor(distid)3030 = 0
## factor(distid)3040 = 0
## factor(distid)3050 = 0
## factor(distid)3060 = 0
## factor(distid)3070 = 0
## factor(distid)3080 = 0
## factor(distid)3100 = 0
## factor(distid)3440 = 0
## factor(distid)4000 = 0
## factor(distid)4010 = 0
## factor(distid)5010 = 0
## factor(distid)5035 = 0
## factor(distid)5040 = 0
## factor(distid)5060 = 0
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## factor(distid)7010 = 0
## factor(distid)7040 = 0
## factor(distid)8010 = 0
## factor(distid)8030 = 0
## factor(distid)8050 = 0
## factor(distid)9010 = 0
## factor(distid)9030 = 0
## factor(distid)9050 = 0
## factor(distid)9090 = 0
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## factor(distid)11200 = 0
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## factor(distid)11240 = 0
## factor(distid)11250 = 0
## factor(distid)11300 = 0
## factor(distid)11310 = 0
```

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## factor(distid)63180 = 0
## factor(distid)63190 = 0
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## factor(distid)63270 = 0
## factor(distid)63280 = 0
## factor(distid)63290 = 0
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## factor(distid)64000 = 0
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## factor(distid)66045 = 0
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```

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## factor(distid)67050 = 0
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## factor(distid)75060 = 0
## factor(distid)75070 = 0
## factor(distid)75080 = 0
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```

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## factor(distid)78100 = 0
## factor(distid)78110 = 0
## factor(distid)79010 = 0
## factor(distid)79020 = 0
## factor(distid)79030 = 0
## factor(distid)79080 = 0
## factor(distid)79090 = 0
## factor(distid)79100 = 0
## factor(distid)79110 = 0
## factor(distid)79145 = 0
## factor(distid)79150 = 0
## factor(distid)80000 = 0
## factor(distid)80010 = 0
## factor(distid)80020 = 0
## factor(distid)80050 = 0
## factor(distid)80090 = 0
## factor(distid)80110 = 0
## factor(distid)80120 = 0
## factor(distid)80130 = 0
## factor(distid)80140 = 0
## factor(distid)80150 = 0
## factor(distid)80160 = 0
## factor(distid)81000 = 0
## factor(distid)81010 = 0
## factor(distid)81020 = 0
## factor(distid)81040 = 0
## factor(distid)81050 = 0
## factor(distid)81070 = 0
## factor(distid)81080 = 0
## factor(distid)81100 = 0
## factor(distid)81120 = 0
## factor(distid)81140 = 0
## factor(distid)81150 = 0
## factor(distid)82010 = 0
## factor(distid)82020 = 0
## factor(distid)82030 = 0
## factor(distid)82040 = 0
## factor(distid)82045 = 0
```

```
## factor(distid)82050 = 0
## factor(distid)82055 = 0
## factor(distid)82060 = 0
## factor(distid)82070 = 0
## factor(distid)82080 = 0
## factor(distid)82090 = 0
## factor(distid)82095 = 0
## factor(distid)82100 = 0
## factor(distid)82110 = 0
## factor(distid)82120 = 0
## factor(distid)82130 = 0
## factor(distid)82140 = 0
## factor(distid)82150 = 0
## factor(distid)82155 = 0
## factor(distid)82160 = 0
## factor(distid)82170 = 0
## factor(distid)82180 = 0
## factor(distid)82230 = 0
## factor(distid)82240 = 0
## factor(distid)82250 = 0
## factor(distid)82290 = 0
## factor(distid)82300 = 0
## factor(distid)82320 = 0
## factor(distid)82340 = 0
## factor(distid)82365 = 0
## factor(distid)82390 = 0
## factor(distid)82400 = 0
## factor(distid)82405 = 0
## factor(distid)82430 = 0
## factor(distid)83010 = 0
## factor(distid)83060 = 0
## factor(distid)83070 = 0
##
## Model 1: restricted model
## Model 2: math4 ~ expp + lunch + factor(distid)
##
##   Res.Df    RSS  Df Sum of Sq      F    Pr(>F)
## 1   3847 882322
## 2   3298 408135 549    474186 6.9795 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

7. Now we will use a specially-designed function to estimate a model with fixed effects. (Using the whole data set once again), use `feols()` from the **fixest** package in R, to estimate the model from step 4 but with fixed effects for `distid`. Save the result as `m4`. Include standard errors clustered at the `distid` level.

```
library(fixest)
```

```
## Warning: package 'fixest' was built under R version 4.2.3
```

```
m4 <- feols(math4 ~ expp + lunch | distid, data = mp)
summary(m4)
```

```
## OLS estimation, Dep. Var.: math4
## Observations: 3,850
## Fixed-effects: distid: 550
## Standard-errors: Clustered (distid)
##       Estimate Std. Error  t value   Pr(>|t|)
## expp  0.012031   0.000486 24.73496  < 2.2e-16 ***
## lunch 0.313515   0.094000  3.33527 0.00090972 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 10.3     Adj. R2: 0.626328
##              Within R2: 0.498917
```

'feols()' uses least squares dummy variable

8. Now add fixed effects for year to your model from step 7 to create a two-way fixed effects model. Keep the standard errors clustered at the `distid` level. Save the results as `m5`.

Same thing except add year

```
m5 <- feols(math4 ~ expp + lunch | distid + year, data = mp)
summary(m5)
```

```
## OLS estimation, Dep. Var.: math4
## Observations: 3,850
## Fixed-effects: distid: 550,  year: 7
## Standard-errors: Clustered (distid)
##        Estimate Std. Error   t value Pr(>|t|)
## expp  -0.000168   0.000710 -0.236864  0.81285
## lunch  0.018441   0.100154  0.184125  0.85398
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 8.2812     Adj. R2: 0.757827
##                Within R2: 9.976e-5
```

9.

```
library(modelsummary)
msummary(list(m1,m2,m3,m4,m5), coef_omit = 'distid')
```

	(1)	(2)	(3)	(4)	(5)
(Intercept)	29.527	0.000	−28.059		
	(1.139)	(0.166)	(4.713)		
expp	0.007		0.012	0.012	0.000

	(1)	(2)	(3)	(4)	(5)
	(0.000)		(0.000)	(0.000)	(0.001)
lunch	−0.381		0.314	0.314	0.018
	(0.016)		(0.054)	(0.094)	(0.100)
expp_demean		0.012			
		(0.000)			
lunch_demean		0.314			
		(0.050)			
Num.Obs.	3850	3850	3850	3850	3850
R2	0.308	0.499	0.680	0.680	0.793
R2 Adj.	0.307	0.499	0.626	0.626	0.758
R2 Within				0.499	0.000
R2 Within Adj.				0.499	−0.001
AIC	31856.6	28888.4	29986.4	29984.4	28319.5
BIC	31881.6	28913.4	33445.9	33437.6	31810.3
Log.Lik.	−15924.294	−14440.199	−14440.199		
RMSE	15.14	10.30	10.30	10.30	8.28
Std.Errors				by: distid	by: distid
FE: distid				X	X
FE: year					X

Its interesting that the intercept for model 3 is almost equal except negative to the first model. Its interesting that the two way effect model has no effect for lunch.

10.

```
library(lme4)
```

```
## Warning: package 'lme4' was built under R version 4.2.3
```

```
## Loading required package: Matrix
```

```
##
## Attaching package: 'Matrix'
```

```
## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack
```

```
mp <- mp %>%
   mutate(distid_factor = factor(distid)) %>%
  group_by(distid) %>%
  mutate(expp_mean = mean(expp),
         lunch_mean = mean(lunch))
m6 <- lmer(math4 ~ (1|distid_factor) + expp_demean + lunch_demean + expp_mean + lunch_mean, data
= mp)
summary(m6)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula:
## math4 ~ (1 | distid_factor) + expp_demean + lunch_demean + expp_mean +
##     lunch_mean
##    Data: mp
##
## REML criterion at convergence: 30287
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.9152 -0.5961  0.0061  0.5836  6.3543
##
## Random effects:
##  Groups        Name        Variance Std.Dev.
##  distid_factor (Intercept)  54.96    7.413
##  Residual                  123.75   11.124
## Number of obs: 3850, groups:  distid_factor, 550
##
## Fixed effects:
##                Estimate Std. Error t value
## (Intercept)  57.0350106  2.2281622  25.597
## expp_demean   0.0120310  0.0002310  52.090
## lunch_demean  0.3135149  0.0542746   5.776
## expp_mean     0.0019855  0.0003995   4.970
## lunch_mean   -0.4413807  0.0242230 -18.222
##
## Correlation of Fixed Effects:
##             (Intr) expp_d lnch_d expp_m
## expp_demean  0.000
## lunch_demen  0.000 -0.323
## expp_mean   -0.941  0.000  0.000
## lunch_mean  -0.303  0.000  0.000  0.007
```