edustat

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Load Packages

```
library(tidyverse)
library(readxl)
library(plm)
library(modelr)
library(stargazer)
```

Load Datasets

```
edustat <- read_rds("edu_datasets/joined_data.rds") %>%
  mutate(입학자중여자 = 입학자_전체_여 / 입학자_전체_계)
```

Conducting OLS

```
# conduct ols

# 조선관련 학과 여부에 따른 취업자 중 여학생 비율
ols <- lm(취업자중여자 ~ shipbuilding + 시도, data = edustat)
summary(ols)
```

Call: lm(formula = 취업자중여자 ~ shipbuilding + 시도, data = edustat)

Residuals: Min 1Q Median 3Q Max -0.5317 -0.3387 -0.0242 0.3683 0.8848

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.426234 0.004098 104.005 < 2e-16 ***shipbuilding -0.311000 0.014484 -21.471 < 2e-16*** 시도부산 0.045670 0.005003 9.128 < 2e-16 ***시도서울 0.105425 0.004493 23.467 < 2e-16*** 시도울산 0.045931 0.009747 4.712 2.45e-06 *** — Signif. codes: 0 '*' ***0.001*** '**' *0.01* '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3644 on 64544 degrees of freedom (6057 observations deleted due to missingness) Multiple R-squared: 0.01992, Adjusted R-squared: 0.01986 F-statistic: 328 on 4 and 64544 DF, p-value: < 2.2e-16

```
# 공학계열 여부에 따른 취업자 중 여학생 비율
ols2 <- lm(취업자중여자 ~ eng + 시도, data = edustat)
summary(ols2)
```

Call: lm(formula = 취업자중여자 ~ eng + 시도, data = edustat)

Residuals: Min 1Q Median 3Q Max -0.61100 -0.21989 -0.01902 0.31332 0.84967

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.533305 0.003781 141.062 < 2e-16 ***eng -0.382970 0.003038 -126.053 < 2e-16*** 시도부산 0.035426 0.004499 7.875 3.46e-15 ***시도서울 0.077695 0.004036 19.252 < 2e-16*** 시도울산 0.063371 0.008762 7.232 4.80e-13 *** — Signif. codes: 0 '*' ***0.001*** '**' *0.01* '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3276 on 64544 degrees of freedom (6057 observations deleted due to missingness) Multiple R-squared: 0.2079, Adjusted R-squared: 0.2079 F-statistic: 4236 on 4 and 64544 DF, p-value: < 2.2e-16

```
# 계열과 지역(서울/경남/부산/울산, 경남이 default)에 따른 취업자 중 여학생 비율
ols3 <- lm(취업자중여자 ~ 시도 + 대계열, data = edustat)
summary(ols3)
```

Call: lm(formula = 취업자중여자 ~ 시도 + 대계열, data = edustat)

Residuals: Min 1Q Median 3Q Max -0.74169 -0.19931 -0.01806 0.27361 0.84629

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.153708 0.004143 37.099 < 2e-16 ***시도부산 0.033134 0.004396 7.536 4.89e-14*** 시도서울 0.072680 0.003956 18.370 < 2e-16 ***시도울산 0.061036 0.008552 7.137 9.67e-13*** 대계열교육계열 0.515298 0.005545 92.932 < 2e-16 ***대계열사회계열 0.295601 0.003772 78.375 < 2e-16*** 대계열예체능계열 0.469543 0.004323 108.619 < 2e-16 ***대계열의약계열 0.435990 0.005634 77.392 < 2e-16*** 대계열인문계열 0.444702 0.004371 101.741 < 2e-16 ***대계열자연계열 0.303183 0.004053 74.801 < 2e-16*** — Signif. codes: 0 ‘’ ***0.001*** ’’ *0.01* ” 0.05 ‘.’ 0.1 ’ ’ 1

Residual standard error: 0.3192 on 64539 degrees of freedom (6057 observations deleted due to missingness) Multiple R-squared: 0.248, Adjusted R-squared: 0.2479 F-statistic: 2365 on 9 and 64539 DF, p-value: < 2.2e-16

```
stargazer(ols, ols2, ols3, type = "latex")
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Sun, Dec 11, 2022 - 15:54:40

Conducting Fixed Effects

```
fixed <- plm(취업자중여자 ~ factor(eng) + 시도, index = "연도", model = "within", data = edustat)

summary(fixed)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(eng) + 시도, data = edustat,
##     model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 5328-6779, N = 64549
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.621445 -0.214662 -0.019786  0.310447  0.865219
##
## Coefficients:
##                Estimate Std. Error   t-value  Pr(>|t|)
## factor(eng)1 -0.3830620  0.0030377 -126.1031 < 2.2e-16 ***
## 시도부산      0.0353929  0.0044979    7.8688 3.637e-15 ***
## 시도서울      0.0774404  0.0040357   19.1886 < 2.2e-16 ***
## 시도울산      0.0626913  0.0087615    7.1553 8.435e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8740.1
```

Table 1:

	Dependent variable:		
	취업자중여자		
	(1)	(2)	(3)
shipbuilding	-0.311^{***}		
	(0.014)		
eng		-0.383^{***}	
		(0.003)	
시도부산	0.046^{***}	0.035^{***}	0.033^{***}
	(0.005)	(0.004)	(0.004)
시도서울	0.105^{***}	0.078^{***}	0.073^{***}
	(0.004)	(0.004)	(0.004)
시도울산	0.046^{***}	0.063^{***}	0.061^{***}
	(0.010)	(0.009)	(0.009)
대계열교육계열			0.515^{***}
			(0.006)
대계열사회계열			0.296^{***}
			(0.004)
대계열예체능계열			0.470^{***}
			(0.004)
대계열의약계열			0.436^{***}
			(0.006)
대계열인문계열			0.445^{***}
			(0.004)
대계열자연계열			0.303^{***}
			(0.004)
Constant	0.426^{***}	0.533^{***}	0.154^{***}
	(0.004)	(0.004)	(0.004)
Observations	64,549	64,549	64,549
R^2	0.020	0.208	0.248
Adjusted R^2	0.020	0.208	0.248
Residual Std. Error	0.364 (df = 64544)	0.328 (df = 64544)	0.319 (df = 64539)
F Statistic	327.993^{***} (df = 4; 64544)	$4{,}235.568^{***}$ (df = 4; 64544)	$2{,}365.475^{***}$ (df = 9; 64539)
Note:			*p<0.1; **p<0.05; ***p<0.01

```
## Residual Sum of Squares: 6922
## R-Squared:      0.20802
## Adj. R-Squared: 0.20786
## F-statistic: 4237.68 on 4 and 64535 DF, p-value: < 2.22e-16
```

```
fixef(fixed)
```

```
##    2011    2012    2013    2014    2015    2016    2017    2018    2019    2020
## 0.52772 0.51784 0.52635 0.53043 0.53184 0.53494 0.54144 0.53722 0.54064 0.54400
```

```
fixed2 <- plm(취업자중여자 ~ factor(shipbuilding) + 시도, index = "연도", model = "within", data = edustat
summary(fixed2)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(shipbuilding) + 시도,
##     data = edustat, model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 5328-6779, N = 64549
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.540141 -0.340141 -0.015939  0.367349  0.900171
##
## Coefficients:
##                          Estimate Std. Error  t-value  Pr(>|t|)
## factor(shipbuilding)1 -0.3109000  0.0144831 -21.4663 < 2.2e-16 ***
## 시도부산               0.0456425  0.0050030   9.1230 < 2.2e-16 ***
## 시도서울               0.1052099  0.0044931  23.4160 < 2.2e-16 ***
## 시도울산               0.0453202  0.0097471   4.6496 3.332e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8740.1
## Residual Sum of Squares: 8566.4
## R-Squared:      0.019869
## Adj. R-Squared: 0.019671
## F-statistic: 327.056 on 4 and 64535 DF, p-value: < 2.22e-16
```

```
fixef(fixed2)
```

```
##    2011    2012    2013    2014    2015    2016    2017    2018    2019    2020
## 0.42280 0.41073 0.42066 0.42395 0.42480 0.42834 0.43367 0.43153 0.43043 0.43493
```

```
fixed3 <- plm(취업자중여자 ~ 대계열, index = c("연도", "시도"), model = "within", data = edustat)
```

```
## Warning in pdata.frame(data, index): duplicate couples (id-time) in resulting pdata.frame
##  to find out which, use, e.g., table(index(your_pdataframe), useNA = "ifany")
```

```
summary(fixed3)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 대계열, data = edustat,
##     model = "within", index = c("연도", "시도"))
##
```

```
## Balanced Panel: n = 10, T = 4, N = 64549
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.729857 -0.204727 -0.010965  0.278742  0.812019
##
## Coefficients:
##                    Estimate Std. Error t-value  Pr(>|t|)
## 대계열교육계열    0.5160706  0.0055538  92.922 < 2.2e-16 ***
## 대계열사회계열    0.2987110  0.0037770  79.087 < 2.2e-16 ***
## 대계열예체능계열 0.4777222  0.0043167 110.668 < 2.2e-16 ***
## 대계열의약계열    0.4344513  0.0056491  76.906 < 2.2e-16 ***
## 대계열인문계열    0.4546523  0.0043526 104.455 < 2.2e-16 ***
## 대계열자연계열    0.3086743  0.0040534  76.152 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8740.1
## Residual Sum of Squares: 6613.7
## R-Squared:      0.24329
## Adj. R-Squared: 0.24311
## F-statistic: 3457.98 on 6 and 64533 DF, p-value: < 2.22e-16
```

```
fixef(fixed3)
```

```
##    2011    2012    2013    2014    2015    2016    2017    2018    2019    2020
## 0.19483 0.18798 0.19605 0.20088 0.20180 0.20510 0.21225 0.20823 0.21118 0.21379
```

```
fixed4 <- plm(취업자중여자 ~ 대계열 + 시도, index = "연도", model = "within", data = edustat)
summary(fixed3)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 대계열, data = edustat,
##     model = "within", index = c("연도", "시도"))
##
## Balanced Panel: n = 10, T = 4, N = 64549
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.729857 -0.204727 -0.010965  0.278742  0.812019
##
## Coefficients:
##                    Estimate Std. Error t-value  Pr(>|t|)
## 대계열교육계열    0.5160706  0.0055538  92.922 < 2.2e-16 ***
## 대계열사회계열    0.2987110  0.0037770  79.087 < 2.2e-16 ***
## 대계열예체능계열 0.4777222  0.0043167 110.668 < 2.2e-16 ***
## 대계열의약계열    0.4344513  0.0056491  76.906 < 2.2e-16 ***
## 대계열인문계열    0.4546523  0.0043526 104.455 < 2.2e-16 ***
## 대계열자연계열    0.3086743  0.0040534  76.152 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8740.1
```

```
## Residual Sum of Squares: 6613.7
## R-Squared:      0.24329
## Adj. R-Squared: 0.24311
## F-statistic: 3457.98 on 6 and 64533 DF, p-value: < 2.22e-16
```

```
fixef(fixed3)
```

```
##    2011    2012    2013    2014    2015    2016    2017    2018    2019    2020
## 0.19483 0.18798 0.19605 0.20088 0.20180 0.20510 0.21225 0.20823 0.21118 0.21379
```

```
pFtest(fixed, ols)
```

```
##
##  F test for individual effects
##
## data:  취업자중여자 ~ factor(eng) + 시도
## F = 1706.7, df1 = 9, df2 = 64535, p-value < 2.2e-16
## alternative hypothesis: significant effects
```

```
pFtest(fixed2, ols2)
```

```
##
##  F test for individual effects
##
## data:  취업자중여자 ~ factor(shipbuilding) + 시도
## F = -1373.4, df1 = 9, df2 = 64535, p-value = 1
## alternative hypothesis: significant effects
```

```
pFtest(fixed3, ols3)
```

```
##
##  F test for individual effects
##
## data:  취업자중여자 ~ 대계열
## F = -63.211, df1 = 6, df2 = 64533, p-value = 1
## alternative hypothesis: significant effects
```

There are few differences of results among ols, fixed-effects, and random-effects.

Random Effects

```
random1 <- plm(취업자중여자 ~ 대계열, index = c("연도", "시도"), model = "random", data = edustat)
```

```
## Warning in pdata.frame(data, index): duplicate couples (id-time) in resulting pdata.frame
##  to find out which, use, e.g., table(index(your_pdataframe), useNA = "ifany")
```

```
summary(random1)
```

```
## Oneway (individual) effect Random Effect Model
##    (Swamy-Arora's transformation)
##
## Call:
## plm(formula = 취업자중여자 ~ 대계열, data = edustat,
##     model = "random", index = c("연도", "시도"))
##
## Balanced Panel: n = 10, T = 4, N = 64549
##
## Effects:
```

```
##                  var std.dev share
## idiosyncratic 0.1025  0.3201     1
## individual    0.0000  0.0000     0
## theta: 0
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.719504 -0.203594 -0.012036  0.280496  0.796406
##
## Coefficients:
##                   Estimate Std. Error z-value  Pr(>|z|)
## (Intercept)      0.2035944  0.0025804  78.900 < 2.2e-16 ***
## 대계열교육계열   0.5159094  0.0055551  92.872 < 2.2e-16 ***
## 대계열사회계열   0.2986746  0.0037778  79.060 < 2.2e-16 ***
## 대계열예체능계열 0.4774579  0.0043174 110.589 < 2.2e-16 ***
## 대계열의약계열   0.4350990  0.0056492  77.019 < 2.2e-16 ***
## 대계열인문계열   0.4545516  0.0043535 104.410 < 2.2e-16 ***
## 대계열자연계열   0.3084417  0.0040541  76.081 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8743.7
## Residual Sum of Squares: 6617.9
## R-Squared:      0.24313
## Adj. R-Squared: 0.24306
## Chisq: 20732.4 on 6 DF, p-value: < 2.22e-16
```

Only conducting analysis with '공학계열'

```
edustat2 <- edustat %>%
  mutate(입학자중여자 = 입학자_전체_여 / 입학자_전체_계) %>%
  filter(대계열 %in% c("공학계열"))

ols4 <- lm(취업자중여자 ~ 시도, data = edustat2)
summary(ols4)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 시도, data = edustat2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.23587 -0.18082 -0.09301  0.09747  0.86412
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.135885   0.005355  25.376  < 2e-16 ***
## 시도부산    0.044933   0.006683   6.723 1.84e-11 ***
## 시도서울    0.099982   0.006094  16.407  < 2e-16 ***
## 시도울산    0.064228   0.012194   5.267 1.40e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2622 on 15395 degrees of freedom
```

```
##   (860 observations deleted due to missingness)
## Multiple R-squared:  0.02008,    Adjusted R-squared:  0.01989
## F-statistic: 105.2 on 3 and 15395 DF,  p-value: < 2.2e-16
```

학력별 분석

```
# 전문대

ols_technical <- lm(취업자중여자 ~ 대계열 + 시도, data = edustat %>% filter(학제 %in% c("전문대학(2년제)",
summary(ols_technical)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도, data = edustat %>%
##     filter(학제 %in% c("전문대학(2년제)", "전문대학(3년제)",
##         "전문대학(4년제)", "기능대학")))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.8897 -0.1265 -0.0078  0.1992  0.9264
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.073566   0.006952  10.581  < 2e-16 ***
## 대계열교육계열   0.827106   0.014319  57.764  < 2e-16 ***
## 대계열사회계열   0.503606   0.008273  60.871  < 2e-16 ***
## 대계열예체능계열 0.517459   0.008774  58.978  < 2e-16 ***
## 대계열의약계열   0.627425   0.010039  62.496  < 2e-16 ***
## 대계열인문계열   0.571733   0.013548  42.202  < 2e-16 ***
## 대계열자연계열   0.497410   0.013038  38.151  < 2e-16 ***
## 시도부산         0.046756   0.007780   6.009 1.95e-09 ***
## 시도서울         0.188706   0.007805  24.178  < 2e-16 ***
## 시도울산         0.038863   0.012957   2.999  0.00272 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2523 on 7415 degrees of freedom
##   (140 observations deleted due to missingness)
## Multiple R-squared:  0.5476, Adjusted R-squared:  0.547
## F-statistic: 997.2 on 9 and 7415 DF,  p-value: < 2.2e-16
```

```
ols_technical_ship <- lm(취업자중여자 ~ 대계열 + 시도 + shipbuilding, data = edustat %>% filter(학제 %in%
summary(ols_technical_ship)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도 + shipbuilding,
##     data = edustat %>% filter(학제 %in% c("전문대학(2년제)",
##         "전문대학(3년제)", "전문대학(4년제)", "기능대학")))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.89029 -0.12875 -0.00863  0.19911  0.92887
##
## Coefficients:
```

```
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.071130   0.007311   9.729  < 2e-16 ***
## 대계열교육계열   0.828624   0.014388  57.593  < 2e-16 ***
## 대계열사회계열   0.505112   0.008391  60.198  < 2e-16 ***
## 대계열예체능계열 0.518821   0.008864  58.529  < 2e-16 ***
## 대계열의약계열   0.629046   0.010152  61.965  < 2e-16 ***
## 대계열인문계열   0.573024   0.013600  42.133  < 2e-16 ***
## 대계열자연계열   0.498987   0.013120  38.033  < 2e-16 ***
## 시도부산         0.047813   0.007842   6.097 1.14e-09 ***
## 시도서울         0.190110   0.007913  24.025  < 2e-16 ***
## 시도울산         0.040132   0.013011   3.085  0.00205 **
## shipbuilding     0.023050   0.021409   1.077  0.28166
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2523 on 7414 degrees of freedom
##   (140 observations deleted due to missingness)
## Multiple R-squared:  0.5477, Adjusted R-squared:  0.5471
## F-statistic: 897.6 on 10 and 7414 DF,  p-value: < 2.2e-16
```

```
fixed_technical_eng <- plm(취업자중여자 ~ factor(eng) + 시도, index = "연도", model = "within", data = edu
summary(fixed_technical_eng)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(eng) + 시도, data = edustat %>%
##     filter(학제 %in% c("전문대학(2년제)", "전문대학(3년제)",
##         "전문대학(4년제)", "기능대학")), model = "within",
##     index = "연도")
##
## Unbalanced Panel: n = 10, T = 720-766, N = 7425
##
## Residuals:
##       Min.    1st Qu.     Median    3rd Qu.       Max.
## -0.8249394 -0.1434566 -0.0044241  0.1891604  0.9226857
##
## Coefficients:
##                Estimate Std. Error  t-value  Pr(>|t|)
## factor(eng)1 -0.5572267  0.0067681 -82.3313 < 2.2e-16 ***
## 시도부산      0.0430921  0.0080739   5.3372 9.718e-08 ***
## 시도서울      0.1762985  0.0079528  22.1680 < 2.2e-16 ***
## 시도울산      0.0596492  0.0133884   4.4553 8.501e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1042.4
## Residual Sum of Squares: 510.59
## R-Squared:      0.51019
## Adj. R-Squared: 0.50933
## F-statistic: 1929.83 on 4 and 7411 DF, p-value: < 2.22e-16
```

```
fixed_technical_ship <- plm(취업자중여자 ~ factor(shipbuilding) + 시도, index = "연도", model = "within",
summary(fixed_technical_ship)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(shipbuilding) + 시도,
##     data = edustat %>% filter(학제 %in% c("전문대학(2년제)",
##         "전문대학(3년제)", "전문대학(4년제)", "기능대학")),
##     model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 720-766, N = 7425
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.669665 -0.353065  0.048717  0.336922  0.582110
##
## Coefficients:
##                         Estimate Std. Error  t-value  Pr(>|t|)
## factor(shipbuilding)1 -0.353698   0.029877 -11.8383 < 2.2e-16 ***
## 시도부산               0.122835   0.011072  11.0941 < 2.2e-16 ***
## 시도서울               0.219104   0.011025  19.8729 < 2.2e-16 ***
## 시도울산               0.108783   0.018413   5.9079 3.618e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1042.4
## Residual Sum of Squares: 959.46
## R-Squared:      0.079591
## Adj. R-Squared: 0.077977
## F-statistic: 160.214 on 4 and 7411 DF, p-value: < 2.22e-16
```

```
# 학사

ols_undergraduate <- lm(취업자중여자 ~ 대계열 + 시도, data = edustat %>% filter(학제 == "대학교"))
summary(ols_undergraduate)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도, data = edustat %>%
##     filter(학제 == "대학교"))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.7249 -0.1826 -0.0110  0.2114  0.7851
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       0.214921   0.005622  38.227  < 2e-16 ***
## 대계열교육계열    0.360711   0.007562  47.701  < 2e-16 ***
## 대계열사회계열    0.264776   0.005038  52.560  < 2e-16 ***
## 대계열예체능계열 0.443611   0.005632  78.766  < 2e-16 ***
## 대계열의약계열    0.431036   0.009321  46.243  < 2e-16 ***
## 대계열인문계열    0.386106   0.005483  70.414  < 2e-16 ***
## 대계열자연계열    0.277784   0.005603  49.579  < 2e-16 ***
## 시도부산          0.023198   0.005655   4.102  4.1e-05 ***
## 시도서울          0.066350   0.005202  12.753  < 2e-16 ***
## 시도울산          0.043092   0.011994   3.593 0.000328 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2763 on 28026 degrees of freedom
##   (904 observations deleted due to missingness)
## Multiple R-squared:  0.2432, Adjusted R-squared:  0.243
## F-statistic:  1001 on 9 and 28026 DF,  p-value: < 2.2e-16
```

```
## 학사 조선관련 학과
ols_undergraduate_ship <- lm(취업자중여자 ~ 대계열 + 시도 + shipbuilding, data = edustat %>% filter(학제 =
summary(ols_undergraduate_ship)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도 + shipbuilding,
##     data = edustat %>% filter(학제 == "대학교"))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.72474 -0.18283 -0.01139  0.21116  0.81025
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.216060   0.005682  38.025  < 2e-16 ***
## 대계열교육계열     0.359720   0.007596  47.359  < 2e-16 ***
## 대계열사회계열     0.263772   0.005090  51.826  < 2e-16 ***
## 대계열예체능계열   0.442643   0.005675  77.997  < 2e-16 ***
## 대계열의약계열     0.430007   0.009351  45.987  < 2e-16 ***
## 대계열인문계열     0.385151   0.005527  69.691  < 2e-16 ***
## 대계열자연계열     0.276810   0.005647  49.020  < 2e-16 ***
## 시도부산           0.023293   0.005655   4.119 3.82e-05 ***
## 시도서울           0.066038   0.005207  12.682  < 2e-16 ***
## 시도울산           0.043208   0.011994   3.602 0.000316 ***
## shipbuilding      -0.026312   0.019017  -1.384 0.166494
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2762 on 28025 degrees of freedom
##   (904 observations deleted due to missingness)
## Multiple R-squared:  0.2433, Adjusted R-squared:  0.243
## F-statistic: 900.9 on 10 and 28025 DF,  p-value: < 2.2e-16
```

```
## fixed effects with eng factor
fixed_undergrad_eng <- plm(취업자중여자 ~ factor(eng) + 시도, index = "연도", model = "within", data = edu
summary(fixed_undergrad_eng)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(eng) + 시도, data = edustat %>%
##     filter(학제 == "대학교"), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 2483-3059, N = 28036
##
## Residuals:
```

```
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.632277 -0.199156 -0.015825  0.225451  0.793742
##
## Coefficients:
##                Estimate Std. Error  t-value  Pr(>|t|)
## factor(eng)1 -0.3410962  0.0042200 -80.8276 < 2.2e-16 ***
## 시도부산      0.0309593  0.0057726   5.3632 8.242e-08 ***
## 시도서울      0.0790509  0.0052922  14.9373 < 2.2e-16 ***
## 시도울산      0.0563934  0.0122761   4.5938 4.372e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    2825.8
## Residual Sum of Squares: 2255.2
## R-Squared:      0.20191
## Adj. R-Squared: 0.20154
## F-statistic: 1772.34 on 4 and 28022 DF, p-value: < 2.22e-16
```

```
## fixed effects with shipbuilding factor
fixed_undergrad_ship <- plm(취업자중여자 ~ factor(shipbuilding) + 시도, index = "연도", model = "within",
summary(fixed_undergrad_ship)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(shipbuilding) + 시도,
##     data = edustat %>% filter(학제 == "대학교"), model = "within",
##     index = "연도")
##
## Unbalanced Panel: n = 10, T = 2483-3059, N = 28036
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.575390 -0.252233 -0.003072  0.268154  0.811686
##
## Coefficients:
##                          Estimate Std. Error  t-value  Pr(>|t|)
## factor(shipbuilding)1 -0.2878129  0.0213017 -13.5112 < 2.2e-16 ***
## 시도부산               0.0363170  0.0063896   5.6838  1.33e-08 ***
## 시도서울               0.0992635  0.0058562  16.9502 < 2.2e-16 ***
## 시도울산               0.0494006  0.0135880   3.6356 0.0002778 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    2825.8
## Residual Sum of Squares: 2763
## R-Squared:      0.022212
## Adj. R-Squared: 0.021759
## F-statistic: 159.143 on 4 and 28022 DF, p-value: < 2.22e-16
```

```
# 대학원

ols_graduate <- ols_technical <- lm(취업자중여자 ~ 대계열 + 시도, data = edustat %>% filter(학제 == "일반다
summary(ols_graduate)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도, data = edustat %>%
##     filter(학제 == "일반대학원"))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.78158 -0.20178 -0.04178  0.33328  0.88357
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       0.116426   0.008540  13.634  < 2e-16 ***
## 대계열교육계열    0.579797   0.009691  59.827  < 2e-16 ***
## 대계열사회계열    0.247756   0.006590  37.597  < 2e-16 ***
## 대계열예체능계열 0.448385   0.008333  53.810  < 2e-16 ***
## 대계열의약계열    0.381894   0.009001  42.428  < 2e-16 ***
## 대계열인문계열    0.464934   0.007744  60.042  < 2e-16 ***
## 대계열자연계열    0.300671   0.006444  46.661  < 2e-16 ***
## 시도부산          0.035095   0.009248   3.795 0.000148 ***
## 시도서울          0.085357   0.008248  10.349  < 2e-16 ***
## 시도울산          0.062641   0.016923   3.702 0.000215 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3616 on 27747 degrees of freedom
##   (4964 observations deleted due to missingness)
## Multiple R-squared:  0.2134, Adjusted R-squared:  0.2131
## F-statistic: 836.2 on 9 and 27747 DF,  p-value: < 2.2e-16
```

```
## 대학원 조선관련 학과
ols_graduate_ship <- ols_technical <- lm(취업자중여자 ~ 대계열 + 시도 + shipbuilding, data = edustat %>% f
summary(ols_graduate_ship)
```

```
##
## Call:
## lm(formula = 취업자중여자 ~ 대계열 + 시도 + shipbuilding,
##     data = edustat %>% filter(학제 == "일반대학원"))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.78141 -0.20259 -0.04206  0.33341  0.91071
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       0.117437   0.008578  13.691  < 2e-16 ***
## 대계열교육계열    0.578823   0.009722  59.535  < 2e-16 ***
## 대계열사회계열    0.246779   0.006636  37.189  < 2e-16 ***
## 대계열예체능계열  0.447429   0.008368  53.471  < 2e-16 ***
## 대계열의약계열    0.380904   0.009036  42.156  < 2e-16 ***
## 대계열인문계열    0.464000   0.007779  59.644  < 2e-16 ***
## 대계열자연계열    0.299694   0.006491  46.171  < 2e-16 ***
## 시도부산          0.035738   0.009263   3.858 0.000114 ***
## 시도서울          0.085151   0.008249  10.322  < 2e-16 ***
## 시도울산          0.062781   0.016923   3.710 0.000208 ***
## shipbuilding     -0.028151   0.022514  -1.250 0.211185
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3616 on 27746 degrees of freedom
##   (4964 observations deleted due to missingness)
## Multiple R-squared:  0.2134, Adjusted R-squared:  0.2131
## F-statistic: 752.7 on 10 and 27746 DF,  p-value: < 2.2e-16
```

```
## fixed effects with eng factor
fixed_grad_eng <- plm(취업자중여자 ~ factor(eng) + 시도, index = "연도", model = "within", data = edustat
summary(fixed_grad_eng)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(eng) + 시도, data = edustat %>%
##     filter(학제 == "일반대학원"), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 1935-2934, N = 27757
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.587661 -0.225218 -0.058166  0.415366  0.918221
##
## Coefficients:
##                Estimate Std. Error  t-value  Pr(>|t|)
## factor(eng)1 -0.3624431  0.0051435 -70.4658 < 2.2e-16 ***
## 시도부산      0.0381946  0.0095148   4.0142  5.98e-05 ***
## 시도서울      0.0930729  0.0084720  10.9859 < 2.2e-16 ***
## 시도울산      0.0511435  0.0174229   2.9354  0.003334 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    4606.4
## Residual Sum of Squares: 3847.6
## R-Squared:      0.16471
## Adj. R-Squared: 0.16432
## F-statistic: 1367.65 on 4 and 27743 DF, p-value: < 2.22e-16
```

```
## fixed effects with shipbuilding factor
fixed_grad_ship <- plm(취업자중여자 ~ factor(shipbuilding) + 시도, index = "연도", model = "within", data
summary(fixed_grad_ship)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ factor(shipbuilding) + 시도,
##     data = edustat %>% filter(학제 == "일반대학원"), model = "within",
##     index = "연도")
##
## Unbalanced Panel: n = 10, T = 1935-2934, N = 27757
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.505452 -0.391629 -0.040246  0.494548  0.904401
```

```
##
## Coefficients:
##                          Estimate Std. Error  t-value  Pr(>|t|)
## factor(shipbuilding)1 -0.2737763  0.0248248 -11.0283 < 2.2e-16 ***
## 시도부산               0.0291573  0.0103236   2.8243  0.004741 **
## 시도서울               0.1216520  0.0091697  13.2667 < 2.2e-16 ***
## 시도울산              -0.0010155  0.0188593  -0.0538  0.957057
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    4606.4
## Residual Sum of Squares: 4516.5
## R-Squared:      0.019508
## Adj. R-Squared: 0.019049
## F-statistic: 137.998 on 4 and 27743 DF, p-value: < 2.22e-16
```

다 합쳐서

```
## 합쳐서

edustat %>%
  mutate(school_age = case_when(학제 %in% c("전문대학(2년제)", "전문대학(3년제)", "전문대학(4년제)", "기능대
                                학제 == "대학교" ~ 학제,
                                학제 == "일반대학원" ~ 학제)) -> edustat3

total_analysis <- plm(취업자중여자 ~ 대계열 + 시도 + school_age, index = "연도", model = "within", data =
summary(total_analysis)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 대계열 + 시도 + school_age,
##     data = edustat3, model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 5144-6715, N = 63218
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.784290 -0.200449 -0.016016  0.265778  0.912472
##
## Coefficients:
##                          Estimate Std. Error  t-value  Pr(>|t|)
## 대계열교육계열         0.5118639  0.0057456  89.0885 < 2.2e-16 ***
## 대계열사회계열         0.2923660  0.0037949  77.0418 < 2.2e-16 ***
## 대계열예체능계열       0.4583503  0.0044025 104.1107 < 2.2e-16 ***
## 대계열의약계열         0.4319544  0.0056339  76.6711 < 2.2e-16 ***
## 대계열인문계열         0.4420809  0.0044061 100.3340 < 2.2e-16 ***
## 대계열자연계열         0.3131822  0.0040789  76.7809 < 2.2e-16 ***
## 시도부산               0.0434479  0.0044810   9.6960 < 2.2e-16 ***
## 시도서울               0.0941085  0.0041176  22.8553 < 2.2e-16 ***
## 시도울산               0.0579971  0.0085515   6.7821 1.195e-11 ***
## school_age일반대학원 -0.0603817  0.0027548 -21.9185 < 2.2e-16 ***
## school_age전문대학     0.0632665  0.0042648  14.8345 < 2.2e-16 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8587.8
## Residual Sum of Squares: 6380.7
## R-Squared:      0.257
## Adj. R-Squared: 0.25677
## F-statistic: 1987.27 on 11 and 63197 DF, p-value: < 2.22e-16
```

```
total_analysis2 <- plm(취업자중여자 ~ 대계열 * 시도 * school_age, index = "연도", model = "within", data =
summary(total_analysis2)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 대계열 * 시도 * school_age,
##     data = edustat3, model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 5144-6715, N = 63218
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.879685 -0.199379 -0.017941  0.233915  0.905012
##
## Coefficients: (1 dropped because of singularities)
##                                                Estimate Std. Error t-value
## 대계열교육계열                                 0.4430557  0.0188678 23.4822
## 대계열사회계열                                 0.3109812  0.0153297 20.2862
## 대계열예체능계열                               0.4039323  0.0227399 17.7632
## 대계열의약계열                                 0.5019186  0.0240964 20.8296
## 대계열인문계열                                 0.4465566  0.0195638 22.8257
## 대계열자연계열                                 0.3150316  0.0165090 19.0824
## 시도부산                                       0.0528330  0.0129145  4.0910
## 시도서울                                       0.1146758  0.0121355  9.4496
## 시도울산                                       0.0695875  0.0261531  2.6608
## school_age일반대학원                          -0.0578843  0.0161276 -3.5891
## school_age전문대학                            -0.0808372  0.0154580 -5.2295
## 대계열교육계열:시도부산                       -0.0499129  0.0256766 -1.9439
## 대계열사회계열:시도부산                       -0.0331252  0.0183839 -1.8019
## 대계열예체능계열:시도부산                     -0.0169557  0.0256368 -0.6614
## 대계열의약계열:시도부산                       -0.0329936  0.0304894 -1.0821
## 대계열인문계열:시도부산                       -0.0513333  0.0229553 -2.2362
## 대계열자연계열:시도부산                        0.0056619  0.0206865  0.2737
## 대계열교육계열:시도서울                       -0.1271318  0.0222057 -5.7252
## 대계열사회계열:시도서울                       -0.0680385  0.0172664 -3.9405
## 대계열예체능계열:시도서울                      0.0589998  0.0242410  2.4339
## 대계열의약계열:시도서울                       -0.1208052  0.0286617 -4.2149
## 대계열인문계열:시도서울                       -0.0791247  0.0211812 -3.7356
## 대계열자연계열:시도서울                       -0.0670634  0.0185743 -3.6106
## 대계열교육계열:시도울산                        0.0262334  0.0740465  0.3543
## 대계열사회계열:시도울산                       -0.0321300  0.0395205 -0.8130
## 대계열예체능계열:시도울산                      0.0343298  0.0432917  0.7930
## 대계열의약계열:시도울산                       -0.1539282  0.0778711 -1.9767
## 대계열인문계열:시도울산                       -0.0435783  0.0456407 -0.9548
## 대계열자연계열:시도울산                        0.0049807  0.0432097  0.1153
## 대계열교육계열:school_age일반대학원            0.0817972  0.0341623  2.3944
```

```
## 대계열사회계열:school_age일반대학원                -0.0572520  0.0258115 -2.2181
## 대계열예체능계열:school_age일반대학원                0.0028261  0.0390667  0.0723
## 대계열의약계열:school_age일반대학원                 -0.0759320  0.0347778 -2.1833
## 대계열인문계열:school_age일반대학원                 0.0726097  0.0350976  2.0688
## 대계열자연계열:school_age일반대학원                 -0.0492808  0.0245938 -2.0038
## 대계열교육계열:school_age전문대학                   0.4124467  0.0398241 10.3567
## 대계열사회계열:school_age전문대학                   0.1451437  0.0246692  5.8836
## 대계열예체능계열:school_age전문대학                 0.0638973  0.0337180  1.8951
## 대계열의약계열:school_age전문대학                   0.0957111  0.0323704  2.9567
## 대계열인문계열:school_age전문대학                   0.0672405  0.0493480  1.3626
## 대계열자연계열:school_age전문대학                   0.0984672  0.0334043  2.9477
## 시도부산:school_age일반대학원                      -0.0272908  0.0191330 -1.4264
## 시도서울:school_age일반대학원                      -0.0370789  0.0178008 -2.0830
## 시도울산:school_age일반대학원                      0.0211053  0.0345906  0.6101
## 시도부산:school_age전문대학                        -0.0190125  0.0217525 -0.8740
## 시도서울:school_age전문대학                        0.0121546  0.0202304  0.6008
## 시도울산:school_age전문대학                        -0.0633458  0.0394266 -1.6067
## 대계열교육계열:시도부산:school_age일반대학원     0.1888101  0.0429239  4.3987
## 대계열사회계열:시도부산:school_age일반대학원    -0.0097243  0.0304066 -0.3198
## 대계열예체능계열:시도부산:school_age일반대학원  0.0125503  0.0442165  0.2838
## 대계열의약계열:시도부산:school_age일반대학원     0.0280521  0.0432014  0.6493
## 대계열인문계열:시도부산:school_age일반대학원     0.0255645  0.0406245  0.6293
## 대계열자연계열:시도부산:school_age일반대학원     0.0498406  0.0302493  1.6477
## 대계열교육계열:시도서울:school_age일반대학원     0.1695248  0.0374603  4.5255
## 대계열사회계열:시도서울:school_age일반대학원     0.0714944  0.0278722  2.5651
## 대계열예체능계열:시도서울:school_age일반대학원 -0.0041311  0.0408389 -0.1012
## 대계열의약계열:시도서울:school_age일반대학원     0.0635433  0.0392459  1.6191
## 대계열인문계열:시도서울:school_age일반대학원     0.0205494  0.0368501  0.5576
## 대계열자연계열:시도서울:school_age일반대학원     0.1057160  0.0269069  3.9290
## 대계열교육계열:시도울산:school_age일반대학원     0.2286878  0.1985169  1.1520
## 대계열사회계열:시도울산:school_age일반대학원     0.0516056  0.0625920  0.8245
## 대계열예체능계열:시도울산:school_age일반대학원  0.0050931  0.0759474  0.0671
## 대계열의약계열:시도울산:school_age일반대학원    -0.0032472  0.0961318 -0.0338
## 대계열인문계열:시도울산:school_age일반대학원    -0.1877093  0.0870009 -2.1576
## 대계열자연계열:시도울산:school_age일반대학원    -0.0648078  0.0571522 -1.1340
## 대계열교육계열:시도부산:school_age전문대학       0.0383722  0.0527390  0.7276
## 대계열사회계열:시도부산:school_age전문대학       0.0693779  0.0323128  2.1471
## 대계열예체능계열:시도부산:school_age전문대학     0.0437585  0.0406286  1.0770
## 대계열의약계열:시도부산:school_age전문대학       0.0273800  0.0430384  0.6362
## 대계열인문계열:시도부산:school_age전문대학       0.0999991  0.0606445  1.6489
## 대계열자연계열:시도부산:school_age전문대학       0.0703252  0.0460434  1.5274
## 대계열교육계열:시도서울:school_age전문대학       0.0389519  0.0525381  0.7414
## 대계열사회계열:시도서울:school_age전문대학       0.1649765  0.0313884  5.2560
## 대계열예체능계열:시도서울:school_age전문대학     0.0477638  0.0386714  1.2351
## 대계열의약계열:시도서울:school_age전문대학       0.1855507  0.0470161  3.9465
## 대계열인문계열:시도서울:school_age전문대학       0.1825588  0.0549482  3.3224
## 대계열자연계열:시도서울:school_age전문대학       0.2784404  0.0449014  6.2011
## 대계열사회계열:시도울산:school_age전문대학       0.0940903  0.0637454  1.4760
## 대계열예체능계열:시도울산:school_age전문대학    -0.0382275  0.0716068 -0.5339
## 대계열의약계열:시도울산:school_age전문대학       0.2432365  0.0887386  2.7410
## 대계열인문계열:시도울산:school_age전문대학       0.0030854  0.1256810  0.0245
## 대계열자연계열:시도울산:school_age전문대학      -0.1261133  0.0842234 -1.4974
##                                                      Pr(>|t|)
## 대계열교육계열                                        < 2.2e-16 ***
```

```
## 대계열사회계열                                  < 2.2e-16 ***
## 대계열예체능계열                                 < 2.2e-16 ***
## 대계열의약계열                                   < 2.2e-16 ***
## 대계열인문계열                                   < 2.2e-16 ***
## 대계열자연계열                                   < 2.2e-16 ***
## 시도부산                                         4.301e-05 ***
## 시도서울                                         < 2.2e-16 ***
## 시도울산                                         0.0077982 **
## school_age일반대학원                             0.0003320 ***
## school_age전문대학                               1.705e-07 ***
## 대계열교육계열:시도부산                          0.0519117 .
## 대계열사회계열:시도부산                          0.0715718 .
## 대계열예체능계열:시도부산                        0.5083708
## 대계열의약계열:시도부산                          0.2791964
## 대계열인문계열:시도부산                          0.0253400 *
## 대계열자연계열:시도부산                          0.7843168
## 대계열교육계열:시도서울                          1.038e-08 ***
## 대계열사회계열:시도서울                          8.140e-05 ***
## 대계열예체능계열:시도서울                        0.0149406 *
## 대계열의약계열:시도서울                          2.503e-05 ***
## 대계열인문계열:시도서울                          0.0001874 ***
## 대계열자연계열:시도서울                          0.0003058 ***
## 대계열교육계열:시도울산                          0.7231279
## 대계열사회계열:시도울산                          0.4162237
## 대계열예체능계열:시도울산                        0.4277884
## 대계열의약계열:시도울산                          0.0480795 *
## 대계열인문계열:시도울산                          0.3396762
## 대계열자연계열:시도울산                          0.9082323
## 대계열교육계열:school_age일반대학원              0.0166517 *
## 대계열사회계열:school_age일반대학원              0.0265531 *
## 대계열예체능계열:school_age일반대학원            0.9423316
## 대계열의약계열:school_age일반대학원              0.0290139 *
## 대계열인문계열:school_age일반대학원              0.0385694 *
## 대계열자연계열:school_age일반대학원              0.0450973 *
## 대계열교육계열:school_age전문대학                < 2.2e-16 ***
## 대계열사회계열:school_age전문대학                4.034e-09 ***
## 대계열예체능계열:school_age전문대학              0.0580903 .
## 대계열의약계열:school_age전문대학                0.0031102 **
## 대계열인문계열:school_age전문대학                0.1730206
## 대계열자연계열:school_age전문대학                0.0032022 **
## 시도부산:school_age일반대학원                    0.1537647
## 시도서울:school_age일반대학원                    0.0372557 *
## 시도울산:school_age일반대학원                    0.5417669
## 시도부산:school_age전문대학                      0.3821006
## 시도서울:school_age전문대학                      0.5479691
## 시도울산:school_age전문대학                      0.1081299
## 대계열교육계열:시도부산:school_age일반대학원     1.091e-05 ***
## 대계열사회계열:시도부산:school_age일반대학원     0.7491143
## 대계열예체능계열:시도부산:school_age일반대학원   0.7765367
## 대계열의약계열:시도부산:school_age일반대학원     0.5161252
## 대계열인문계열:시도부산:school_age일반대학원     0.5291623
## 대계열자연계열:시도부산:school_age일반대학원     0.0994269 .
## 대계열교육계열:시도서울:school_age일반대학원     6.038e-06 ***
## 대계열사회계열:시도서울:school_age일반대학원     0.0103177 *
```

```
## 대계열예체능계열:시도서울:school_age일반대학원 0.9194270
## 대계열의약계열:시도서울:school_age일반대학원   0.1054298
## 대계열인문계열:시도서울:school_age일반대학원   0.5770866
## 대계열자연계열:시도서울:school_age일반대학원   8.540e-05 ***
## 대계열교육계열:시도울산:school_age일반대학원   0.2493330
## 대계열사회계열:시도울산:school_age일반대학원   0.4096715
## 대계열예체능계열:시도울산:school_age일반대학원 0.9465337
## 대계열의약계열:시도울산:school_age일반대학원   0.9730537
## 대계열인문계열:시도울산:school_age일반대학원   0.0309662 *
## 대계열자연계열:시도울산:school_age일반대학원   0.2568192
## 대계열교육계열:시도부산:school_age전문대학     0.4668693
## 대계열사회계열:시도부산:school_age전문대학     0.0317914 *
## 대계열예체능계열:시도부산:school_age전문대학   0.2814684
## 대계열의약계열:시도부산:school_age전문대학     0.5246646
## 대계열인문계열:시도부산:school_age전문대학     0.0991649 .
## 대계열자연계열:시도부산:school_age전문대학     0.1266745
## 대계열교육계열:시도서울:school_age전문대학     0.4584520
## 대계열사회계열:시도서울:school_age전문대학     1.477e-07 ***
## 대계열예체능계열:시도서울:school_age전문대학   0.2167906
## 대계열의약계열:시도서울:school_age전문대학     7.937e-05 ***
## 대계열인문계열:시도서울:school_age전문대학     0.0008930 ***
## 대계열자연계열:시도서울:school_age전문대학     5.640e-10 ***
## 대계열사회계열:시도울산:school_age전문대학     0.1399397
## 대계열예체능계열:시도울산:school_age전문대학   0.5934449
## 대계열의약계열:시도울산:school_age전문대학     0.0061261 **
## 대계열인문계열:시도울산:school_age전문대학     0.9804145
## 대계열자연계열:시도울산:school_age전문대학     0.1343030
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    8587.8
## Residual Sum of Squares: 6201.5
## R-Squared:      0.27787
## Adj. R-Squared: 0.27682
## F-statistic: 296.218 on 82 and 63126 DF, p-value: < 2.22e-16
```

공학만

```
eng_analysis <- plm(취업자중여자 ~ 시도 + school_age, index = "연도", model = "within", data = edustat3 %>
summary(eng_analysis)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 + school_age, data = edustat3 %>%
##     filter(대계열 == "공학계열"), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 1199-1658, N = 15120
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.312466 -0.173289 -0.096113  0.082690  0.916096
##
## Coefficients:
```

```
##                          Estimate Std. Error  t-value  Pr(>|t|)
## 시도부산                0.0414261  0.0068376   6.0586 1.406e-09 ***
## 시도서울                0.1010289  0.0063510  15.9075 < 2.2e-16 ***
## 시도울산                0.0688498  0.0121579   5.6630 1.515e-08 ***
## school_age일반대학원 -0.0855528  0.0046349 -18.4582 < 2.2e-16 ***
## school_age전문대학    -0.0879034  0.0066785 -13.1622 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1067
## Residual Sum of Squares: 1019.9
## R-Squared:      0.044136
## Adj. R-Squared: 0.04325
## F-statistic: 139.492 on 5 and 15105 DF, p-value: < 2.22e-16
```

```
eng_analysis2 <- plm(취업자중여자 ~ 시도 * school_age, index = "연도", model = "within", data = edustat3 %
summary(eng_analysis2)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 * school_age, data = edustat3 %>%
##     filter(대계열 == "공학계열"), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 1199-1658, N = 15120
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.315673 -0.175220 -0.097938  0.081867  0.911993
##
## Coefficients:
##                                 Estimate Std. Error t-value  Pr(>|t|)
## 시도부산                        0.053284   0.010700  4.9798 6.436e-07 ***
## 시도서울                        0.115254   0.010055 11.4618 < 2.2e-16 ***
## 시도울산                        0.070100   0.021667  3.2353  0.001218 **
## school_age일반대학원           -0.057273   0.013362 -4.2862 1.829e-05 ***
## school_age전문대학             -0.079674   0.012810 -6.2199 5.106e-10 ***
## 시도부산:school_age일반대학원 -0.027086   0.015851 -1.7088  0.087501 .
## 시도서울:school_age일반대학원 -0.037493   0.014747 -2.5423  0.011022 *
## 시도울산:school_age일반대학원  0.019967   0.028658  0.6967  0.485974
## 시도부산:school_age전문대학    -0.019739   0.018022 -1.0953  0.273424
## 시도서울:school_age전문대학     0.011358   0.016761  0.6777  0.497996
## 시도울산:school_age전문대학    -0.064581   0.032666 -1.9770  0.048062 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1067
## Residual Sum of Squares: 1018
## R-Squared:      0.045951
## Adj. R-Squared: 0.044688
## F-statistic: 66.1123 on 11 and 15099 DF, p-value: < 2.22e-16
```

조선공학만

```
ship_analysis1 <- plm(취업자중여자 ~ 시도 + school_age, index = "연도", model = "within", data = edustat3
summary(ship_analysis1)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 + school_age, data = edustat3 %>%
##     filter(shipbuilding == 1), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 48-73, N = 647
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.244932 -0.134983 -0.079077  0.058584  0.909439
##
## Coefficients:
##                        Estimate Std. Error t-value  Pr(>|t|)
## 시도부산               0.044422   0.023332  1.9039 0.0573728 .
## 시도서울              -0.021549   0.037259 -0.5784 0.5632309
## 시도울산              -0.029093   0.045893 -0.6339 0.5263506
## school_age일반대학원 -0.083774   0.019681 -4.2565 2.391e-05 ***
## school_age전문대학    -0.088632   0.026240 -3.3777 0.0007757 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    29.898
## Residual Sum of Squares: 28.23
## R-Squared:      0.055769
## Adj. R-Squared: 0.034852
## F-statistic: 7.46554 on 5 and 632 DF, p-value: 8.0741e-07
```

```
ship_analysis2 <- plm(취업자중여자 ~ 시도 * school_age, index = "연도", model = "within", data = edustat3
summary(ship_analysis2)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 * school_age, data = edustat3 %>%
##     filter(shipbuilding == 1), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 48-73, N = 647
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.255704 -0.127874 -0.082507  0.059279  0.904481
##
## Coefficients:
##                                  Estimate Std. Error t-value Pr(>|t|)
## 시도부산                         0.0630180  0.0341213  1.8469  0.06524 .
## 시도서울                        -0.0779778  0.0656287 -1.1882  0.23522
## 시도울산                        -0.0497717  0.0656287 -0.7584  0.44851
## school_age일반대학원            -0.0708843  0.0509512 -1.3912  0.16465
## school_age전문대학              -0.0791606  0.0346576 -2.2841  0.02270 *
```

```
## 시도부산:school_age일반대학원 -0.0308563  0.0559760 -0.5512  0.58166
## 시도서울:school_age일반대학원  0.0728124  0.0849387  0.8572  0.39164
## 시도울산:school_age일반대학원  0.0446726  0.0973879  0.4587  0.64660
## 시도부산:school_age전문대학   -0.0306567  0.0581914 -0.5268  0.59850
## 시도울산:school_age전문대학   -0.0039879  0.2239800 -0.0178  0.98580
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    29.898
## Residual Sum of Squares: 28.104
## R-Squared:      0.059994
## Adj. R-Squared: 0.031509
## F-statistic: 4.00172 on 10 and 627 DF, p-value: 2.5004e-05
```

자연계열

```
sci_analysis <- plm(취업자중여자 ~ 시도 + school_age, index = "연도", model = "within", data = edustat3 %>
summary(sci_analysis)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 + school_age, data = edustat3 %>%
##     filter(대계열 == "자연계열"), model = "within", index = "연도")
##
## Unbalanced Panel: n = 10, T = 844-1070, N = 10379
##
## Residuals:
##      Min.   1st Qu.    Median   3rd Qu.      Max.
## -0.690845 -0.297990 -0.002851  0.320485  0.600791
##
## Coefficients:
##                         Estimate Std. Error t-value  Pr(>|t|)
## 시도부산               0.0739362  0.0125999  5.8680 4.546e-09 ***
## 시도서울               0.0954714  0.0109301  8.7347 < 2.2e-16 ***
## 시도울산               0.0268394  0.0239854  1.1190    0.2632
## school_age일반대학원 -0.0597095  0.0072309 -8.2576 < 2.2e-16 ***
## school_age전문대학     0.1282844  0.0176524  7.2673 3.933e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1325
## Residual Sum of Squares: 1299.3
## R-Squared:      0.019396
## Adj. R-Squared: 0.018072
## F-statistic: 40.9999 on 5 and 10364 DF, p-value: < 2.22e-16
```

```
sci_analysis2 <- plm(취업자중여자 ~ 시도 * school_age, index = "연도", model = "within", data = edustat3 %
summary(sci_analysis2)
```

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = 취업자중여자 ~ 시도 * school_age, data = edustat3 %>%
##     filter(대계열 == "자연계열"), model = "within", index = "연도")
```

```
##
## Unbalanced Panel: n = 10, T = 844-1070, N = 10379
##
## Residuals:
##       Min.    1st Qu.     Median    3rd Qu.       Max.
## -0.8544416 -0.2966165 -0.0074192  0.3193606  0.6168197
##
## Coefficients:
##                                Estimate Std. Error t-value  Pr(>|t|)
## 시도부산                       0.057754   0.018210  3.1715  0.001521 **
## 시도서울                       0.047171   0.015842  2.9777  0.002911 **
## 시도울산                       0.074210   0.038738  1.9157  0.055429 .
## school_age일반대학원          -0.107798   0.020921 -5.1526 2.617e-07 ***
## school_age전문대학             0.016043   0.033373  0.4807  0.630722
## 시도부산:school_age일반대학원  0.022973   0.026393  0.8704  0.384080
## 시도서울:school_age일반대학원  0.069245   0.022731  3.0464  0.002322 **
## 시도울산:school_age일반대학원 -0.042990   0.051250 -0.8388  0.401582
## 시도부산:school_age전문대학    0.053648   0.045736  1.1730  0.240824
## 시도서울:school_age전문대학    0.292406   0.045165  6.4741 9.969e-11 ***
## 시도울산:school_age전문대학   -0.187145   0.083833 -2.2323  0.025614 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    1325
## Residual Sum of Squares: 1290.5
## R-Squared:      0.026012
## Adj. R-Squared: 0.024132
## F-statistic: 25.1484 on 11 and 10358 DF, p-value: < 2.22e-16
```