Regression

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2023-03-24

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.2.2
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.4.0      v purrr   0.3.5
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.5.0
## v readr   2.1.3      v forcats 0.5.2
```

```
## Warning: package 'ggplot2' was built under R version 4.2.2
```

```
## Warning: package 'tibble' was built under R version 4.2.2
```

```
## Warning: package 'tidyr' was built under R version 4.2.2
```

```
## Warning: package 'readr' was built under R version 4.2.2
```

```
## Warning: package 'purrr' was built under R version 4.2.2
```

```
## Warning: package 'dplyr' was built under R version 4.2.2
```

```
## Warning: package 'stringr' was built under R version 4.2.2
```

```
## Warning: package 'forcats' was built under R version 4.2.2
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(here)
```

```
## here() starts at C:/Users/hasie/Desktop/Senior Project/R_SeniorProject
```

```
library(tinytex)
```

```
## Warning: package 'tinytex' was built under R version 4.2.2
```

```
library(estimatr)
```

```
## Warning: package 'estimatr' was built under R version 4.2.2
```

```
library(texreg)
```

```
## Warning: package 'texreg' was built under R version 4.2.2
```

```
## Version:  1.38.6
## Date:     2022-04-06
## Author:   Philip Leifeld (University of Essex)
##
## Consider submitting praise using the praise or praise_interactive functions.
## Please cite the JSS article in your publications -- see citation("texreg").
##
## Attaching package: 'texreg'
##
## The following object is masked from 'package:tidyr':
##
##     extract
```

```
library(stargazer)
```

```
##
## Please cite as:
##
##  Hlavac, Marek (2022). stargazer: Well-Formatted Regression and Summary Statistics Tables.
##  R package version 5.2.3. https://CRAN.R-project.org/package=stargazer
```

```
library(sandwich)
```

```
## Warning: package 'sandwich' was built under R version 4.2.2
```

```
df <- read_csv(here("DATA3.csv"))
```

```
## Rows: 1071 Columns: 12
## -- Column specification -------------------------------------------------------
## Delimiter: ","
## chr  (1): state
## dbl (11): year, total, heroin_synthetic, natural_and_other, avg_age, bachelo...
##
## 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.
```

```
options(scipen = 99)

mod_total <- lm_robust(total ~ PDMP + avg_age + bachelors_pct + median_income
                       + unemp_rate + white_pct + personal_health_care + factor(year) + factor(state), data = df, se_type = "HC1")
```

```
mod2_total <- lm(total ~ PDMP + avg_age + bachelors_pct + median_income
                 + unemp_rate + white_pct + personal_health_care +
            factor(year) + factor(state), data = df)

cov2_total <- vcovHC(mod2_total, type = "HC1")
robust_se2_total <- sqrt(diag(cov2_total))
```

```
mod1_total <- lm(total ~ PDMP + factor(year) + factor(state), data = df)
cov1_total <- vcovHC(mod1_total, type = "HC1")
robust_se1_total <- sqrt(diag(cov1_total))
```

```
fe_vector <- c("Fixed Effects", "Yes", "Yes")
covariate_vector <- c("Covariates", "No", "Yes")
```

```
stargazer(mod1_total, mod2_total, type = "latex",
          se = list(robust_se1_total, robust_se2_total), omit = c("factor"),
          add.lines = list(fe_vector, covariate_vector),
          dep.var.labels = "Total Opioid Overdose Death Rate per 100,000")
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Fri, Jun 02, 2023 - 11:15:39 AM

HEROIN SYNTHETIC

```
mod <- lm_robust(heroin_synthetic ~ PDMP + avg_age + bachelors_pct + median_income
                    + unemp_rate + white_pct + personal_health_care +
                       factor(year) + factor(state), data = df, se_type = "HC1")
```

```
mod2_heroin <- lm(heroin_synthetic ~ PDMP + avg_age + bachelors_pct + median_income
                    + unemp_rate + white_pct + personal_health_care +
                  factor(year) + factor(state), data = df)

cov2_heroin <- vcovHC(mod2_heroin, type = "HC1")
robust_se2_heroin <- sqrt(diag(cov2_heroin))
```

```
mod1_heroin <- lm(heroin_synthetic ~ PDMP + factor(year) + factor(state), data = df)

cov1_heroin <- vcovHC(mod1_heroin, type = "HC1")
robust_se1_heroin <- sqrt(diag(cov1_heroin))
```

Table 1:

	Dependent variable:	
	---	---
	Total Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP	−1.241***	−1.199***
	(0.458)	(0.425)
avg_age		1.444***
		(0.417)
bachelors_pct		1.151***
		(0.276)
median_income		−0.049
		(0.045)
unemp_rate		−0.097
		(0.159)
white_pct		0.183*
		(0.096)
personal_health_care		3.008***
		(0.502)
Constant	−1.039	−88.016***
	(0.676)	(16.452)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R^2	0.723	0.765
Adjusted R^2	0.703	0.747
Residual Std. Error	4.227 (df = 999)	3.904 (df = 993)
F Statistic	36.656*** (df = 71; 999)	41.955*** (df = 77; 993)

Note:	*p<0.1; **p<0.05; ***p<0.01

```r
fe_vector <- c("Fixed Effects", "Yes", "Yes")
covariate_vector <- c("Covariates", "No", "Yes")



stargazer(mod1_heroin, mod2_heroin, type = "latex",
          se = list(robust_se1_heroin, robust_se2_heroin), omit = c("factor"),
          add.lines = list(fe_vector, covariate_vector),
          dep.var.labels = "Heroin and Synthetic Opioid Overdose Death Rate per 100,000")
```

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NATURAL AND OTHER

```r
mod_natural <- lm_robust(natural_and_other ~ PDMP + avg_age + bachelors_pct + median_income
                    + unemp_rate + white_pct + personal_health_care +
                      factor(year) + factor(state), data = df, se_type = "HC1")
```

```r
mod2_natural <- lm(natural_and_other ~ PDMP + avg_age + bachelors_pct + median_income
                    + unemp_rate + white_pct + personal_health_care +
                  factor(year) + factor(state), data = df)

cov2_natural <- vcovHC(mod2_natural, type = "HC1")
robust_se2_natural <- sqrt(diag(cov2_natural))
```

```r
mod1_natural <- lm(natural_and_other ~ PDMP + factor(year) + factor(state), data = df)

cov1_natural <- vcovHC(mod1_natural, type = "HC1")
robust_se1_natural <- sqrt(diag(cov1_natural))
```

```r
fe_vector <- c("Fixed Effects", "Yes", "Yes")
covariate_vector <- c("Covariates", "No", "Yes")
```

Table 2:

	Dependent variable:	
	Heroin and Synthetic Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP	−1.196***	−1.109***
	(0.447)	(0.402)
avg_age		1.927***
		(0.393)
bachelors_pct		1.582***
		(0.259)
median_income		−0.020
		(0.045)
unemp_rate		−0.001
		(0.143)
white_pct		0.178*
		(0.095)
personal_health_care		2.950***
		(0.540)
Constant	−1.133	−112.622***
	(0.694)	(16.073)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R^2	0.683	0.749
Adjusted R^2	0.660	0.730
Residual Std. Error	4.154 (df = 999)	3.702 (df = 993)
F Statistic	30.252*** (df = 71; 999)	38.568*** (df = 77; 993)

Note: *p<0.1; **p<0.05; ***p<0.01

```
stargazer(mod1_natural, mod2_natural, type = "latex",
          se = list(robust_se1_natural, robust_se2_natural), omit = c("factor"),
          add.lines = list(fe_vector, covariate_vector),
          dep.var.labels = "Natural, Semisynthetic, and Other Opioid Overdose Death Rate per 100,000")
```

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METHADONE

```
df2 <- read_csv(here("DATA_METHADONE.csv"))
```

```
## Rows: 1008 Columns: 10
## -- Column specification -------------------------------------------------------
## Delimiter: ","
## chr (1): state
## dbl (9): year, methadone_rate, avg_age, bachelors_pct, median_income, PDMP, ...
##
## 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.
```

```
mod_methadone <- lm_robust(methadone_rate ~ PDMP + avg_age + bachelors_pct + median_income
                  + unemp_rate + white_pct + personal_health_care + factor(year) + factor(state), data = df2, se_type = "HC1")
```

```
mod2_methadone <- lm(methadone_rate ~ PDMP + avg_age + bachelors_pct + median_income
                  + unemp_rate + white_pct + personal_health_care + factor(year) + factor(state), data = df2)
```

```
cov2_methadone <- vcovHC(mod2_methadone, type = "HC1")
robust_se2_methadone <- sqrt(diag(cov2_methadone))
```

```
mod1_methadone <- lm(methadone_rate ~ PDMP + factor(year) + factor(state), data = df2)
```

```
cov1_methadone <- vcovHC(mod1_methadone, type = "HC1")
robust_se1_methadone <- sqrt(diag(cov1_methadone))
```

Table 3:

	Dependent variable:	
	Natural, Semisynthetic, and Other Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP	−0.285*	−0.364**
	(0.168)	(0.165)
avg_age		0.003
		(0.139)
bachelors_pct		−0.286***
		(0.086)
median_income		−0.036**
		(0.017)
unemp_rate		−0.148**
		(0.068)
white_pct		−0.003
		(0.030)
personal_health_care		0.241
		(0.153)
Constant	−0.205	5.656
	(0.288)	(5.489)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R^2	0.739	0.747
Adjusted R^2	0.721	0.727
Residual Std. Error	1.584 (df = 999)	1.566 (df = 993)
F Statistic	39.935*** (df = 71; 999)	38.077*** (df = 77; 993)

Note:	*p<0.1; **p<0.05; ***p<0.01

```
fe_vector <- c("Fixed Effects", "Yes", "Yes")
covariate_vector <- c("Covariates", "No", "Yes")


stargazer(mod1_methadone, mod2_methadone, type = "latex",
          se = list(robust_se1_methadone, robust_se2_methadone), omit = c("factor"),
          add.lines = list(fe_vector, covariate_vector),
          dep.var.labels = "Methadone Overdose Death Rate per 100,000")
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Fri, Jun 02, 2023 - 11:15:40 AM

ALL RESULTS

```
fe_vector_final <- c("Fixed Effects", "Yes", "Yes", "Yes", "Yes")
covariate_vector_final <- c("Covariates", "Yes", "Yes", "Yes", "Yes")


stargazer(mod2_total, mod2_heroin, mod2_natural, mod2_methadone, type = "latex",
          se = list(robust_se2_total, robust_se2_heroin, robust_se2_natural, robust_se2_methadone), omit = c("factor"),
          add.lines = list(fe_vector_final, covariate_vector_final),
          dep.var.labels.include = FALSE,
          dep.var.labels = "Overdose Death Rate per 100,000",
          column.labels = c("All Opioids", "Heroin and Synthetic Opioids", "Natural, Semisynthetic, and Other Opiods", "Methadone"))
```

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Fri, Jun 02, 2023 - 11:15:40 AM

Table 4:

	Dependent variable:	
	Methadone Overdose Death Rate per 100,000	
	(1)	(2)
PDMP	−0.056	−0.048
	(0.070)	(0.069)
avg_age		0.080
		(0.073)
bachelors_pct		0.091**
		(0.038)
median_income		0.009
		(0.007)
unemp_rate		0.071**
		(0.028)
white_pct		0.007
		(0.014)
personal_health_care		0.163***
		(0.061)
Constant	0.308***	−5.696*
	(0.094)	(3.017)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,008	1,008
R^2	0.664	0.679
Adjusted R^2	0.640	0.653
Residual Std. Error	0.607 (df = 939)	0.596 (df = 933)
F Statistic	27.321*** (df = 68; 939)	26.645*** (df = 74; 933)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 5:

	All Opioids	Heroin and Synthetic Opioids	Natural, Semisynthetic, and Other Opiods	Methadone
			Dependent variable:	
	(1)	(2)	(3)	(4)
PDMP	−1.199***	−1.109***	−0.364**	−0.048
	(0.425)	(0.402)	(0.165)	(0.069)
avg_age	1.444***	1.927***	0.003	0.080
	(0.417)	(0.393)	(0.139)	(0.073)
bachelors_pct	1.151***	1.582***	−0.286***	0.091**
	(0.276)	(0.259)	(0.086)	(0.038)
median_income	−0.049	−0.020	−0.036**	0.009
	(0.045)	(0.045)	(0.017)	(0.007)
unemp_rate	−0.097	−0.001	−0.148**	0.071**
	(0.159)	(0.143)	(0.068)	(0.028)
white_pct	0.183*	0.178*	−0.003	0.007
	(0.096)	(0.095)	(0.030)	(0.014)
personal_health_care	3.008***	2.950***	0.241	0.163***
	(0.502)	(0.540)	(0.153)	(0.061)
Constant	−88.016***	−112.622***	5.656	−5.696*
	(16.452)	(16.073)	(5.489)	(3.017)
Fixed Effects	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes
Observations	1,071	1,071	1,071	1,008
R^2	0.765	0.749	0.747	0.679
Adjusted R^2	0.747	0.730	0.727	0.653
Residual Std. Error	3.904 (df = 993)	3.702 (df = 993)	1.566 (df = 993)	0.596 (df = 933)
F Statistic	41.955*** (df = 77; 993)	38.568*** (df = 77; 993)	38.077*** (df = 77; 993)	26.645*** (df = 74; 933)

Note: *p<0.1; **p<0.05; ***p<0.01