

Regression

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```
library(tidyverse)
library(here)
library(tinytex)
library(estimatr)
library(texreg)
library(stargazer)
library(sandwich)

df <- read_csv(here("Cleaned_Data", "DATA.csv"))

df_nwerq <- read_csv(here("Cleaned_Data", "DATA3.csv"))
df %>%
  filter(state != "District of Columbia") %>%
  pull(total) %>%
  mean()
```

```
## [1] 9.402272
```

```
df_nwerq %>%
  filter(state != "District of Columbia") %>%
  pull(total) %>%
  mean()
```

```
## [1] 9.402272
```

```

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",
          covariate.labels = c("PDMP in Operation", "Average Age",
                               "Percentage of Population with Bachelor's Degree",
                               "Median Income (Thousands of Dollars)",
                               "Unemployment Rate",
                               "Percentage of Population that is White",
                               "Personal Healthcare Spending per Capita (Thousands of Dollars)"))

```

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Table 1:

	<i>Dependent variable:</i>	
	Total Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP in Operation	-0.526 (0.471)	-0.795* (0.443)
Average Age		1.372*** (0.424)
Percentage of Population with Bachelor's Degree		1.196*** (0.275)
Median Income (Thousands of Dollars)		-0.049 (0.045)
Unemployment Rate		-0.090 (0.160)
Percentage of Population that is White		0.190** (0.097)
Personal Healthcare Spending per Capita (Thousands of Dollars)		2.997*** (0.503)
Constant	-1.289* (0.683)	-86.595*** (16.531)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R ²	0.721	0.764
Adjusted R ²	0.701	0.746
Residual Std. Error	4.240 (df = 999)	3.912 (df = 993)
F Statistic	36.363*** (df = 71; 999)	41.724*** (df = 77; 993)
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01

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))
```

```
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",
           covariate.labels = c("PDMP in Operation", "Average Age",
                                "Percentage of Population with Bachelor's Degree",
                                "Median Income (Thousands of Dollars)",
                                "Unemployment Rate",
                                "Percentage of Population that is White",
                                "Personal Healthcare Spending per Capita (Thousands of Dollars)"))
```

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Table 2:

	<i>Dependent variable:</i>	
	Heroin and Synthetic Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP in Operation	−0.430 (0.454)	−0.728* (0.415)
Average Age		1.860*** (0.399)
Percentage of Population with Bachelor's Degree		1.624*** (0.257)
Median Income (Thousands of Dollars)		−0.021 (0.045)
Unemployment Rate		0.005 (0.143)
Percentage of Population that is White		0.184* (0.096)
Personal Healthcare Spending per Capita (Thousands of Dollars)		2.940*** (0.542)
Constant	−1.400** (0.701)	−111.298*** (16.149)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R ²	0.681	0.748
Adjusted R ²	0.658	0.729
Residual Std. Error	4.167 (df = 999)	3.710 (df = 993)
F Statistic	29.990*** (df = 71; 999)	38.359*** (df = 77; 993)
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01

PRESCRIPTION

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

```
mod2_prescription <- lm(prescription ~ PDMP + avg_age + bachelors_pct + median_income
                        + unemp_rate + white_pct + personal_health_care +
                        factor(year) + factor(state), data = df)
```

```
cov2_prescription <- vcovHC(mod2_prescription, type = "HC1")
robust_se2_prescription <- sqrt(diag(cov2_prescription))
```

```
mod1_prescription <- lm(prescription ~ PDMP + factor(year) + factor(state), data = df)
```

```
cov1_prescription <- vcovHC(mod1_prescription, type = "HC1")
robust_se1_prescription <- sqrt(diag(cov1_prescription))
```

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

```
stargazer(mod1_prescription, mod2_prescription, type = "latex",
           se = list(robust_se1_prescription, robust_se2_prescription), omit = c("factor"),
           add.lines = list(fe_vector, covariate_vector),
           dep.var.labels = "Natural, Semisynthetic, and Other Opioid Overdose Death Rate per 100,000",
           covariate.labels = c("PDMP in Operation", "Average Age",
                                "Percentage of Population with Bachelor's Degree",
                                "Median Income (Thousands of Dollars)",
                                "Unemployment Rate",
                                "Percentage of Population that is White",
                                "Personal Healthcare Spending per Capita (Thousands of Dollars)"))
```

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Table 3:

	<i>Dependent variable:</i>	
	Natural, Semisynthetic, and Other Opioid Overdose Death Rate per 100,000	
	(1)	(2)
PDMP in Operation	−0.345** (0.168)	−0.329* (0.170)
Average Age		−0.017 (0.140)
Percentage of Population with Bachelor's Degree		−0.273*** (0.085)
Median Income (Thousands of Dollars)		−0.036** (0.017)
Unemployment Rate		−0.146** (0.068)
Percentage of Population that is White		−0.001 (0.030)
Personal Healthcare Spending per Capita (Thousands of Dollars)		0.241 (0.153)
Constant	−0.187 (0.287)	5.971 (5.515)
Fixed Effects	Yes	Yes
Covariates	No	Yes
Observations	1,071	1,071
R ²	0.740	0.747
Adjusted R ²	0.721	0.727
Residual Std. Error	1.583 (df = 999)	1.567 (df = 993)
F Statistic	40.004*** (df = 71; 999)	38.039*** (df = 77; 993)

Note:

*p<0.1; **p<0.05; ***p<0.01

METHADONE

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

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))

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",
          covariate.labels = c("PDMP in Operation", "Average Age",
                               "Percentage of Population with Bachelor's Degree",
                               "Median Income (Thousands of Dollars)",
                               "Unemployment Rate",
                               "Percentage of Population that is White",
                               "Personal Healthcare Spending per Capita (Thousands of Dollars)"))
```

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Table 4:

	<i>Dependent variable:</i>	
	Methadone Overdose Death Rate per 100,000	
	(1)	(2)
PDMP in Operation	0.017 (0.070)	−0.009 (0.068)
Average Age		0.074 (0.073)
Percentage of Population with Bachelor's Degree		0.092** (0.037)
Median Income (Thousands of Dollars)		0.009 (0.007)
Unemployment Rate		0.071** (0.028)
Percentage of Population that is White		0.007 (0.014)
Personal Healthcare Spending per Capita (Thousands of Dollars)		0.163*** (0.061)
Constant	0.282*** (0.093)	−5.506* (3.019)
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	27.295*** (df = 68; 939)	26.625*** (df = 74; 933)
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01

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_prescription, mod2_methadone, type = "latex",
  se = list(robust_se2_total, robust_se2_heroin, robust_se2_prescription, 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 Opioids", "Methadone"),
  covariate.labels = c("PDMP in Operation", "Average Age",
    "Percentage of Population with Bachelor's Degree",
    "Median Income (Thousands of Dollars)",
    "Unemployment Rate",
    "Percentage of Population that is White",
    "Personal Healthcare Spending per Capita (Thousands of Dollars)"))
```

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Table 5:

	<i>Dependent variable:</i>		
	All Opioids (1)	Heroin and Synthetic Opioids (2)	Natural, Semisynthetic, and Other (3)
PDMP in Operation	−0.795* (0.443)	−0.728* (0.415)	−0.329* (0.170)
Average Age	1.372*** (0.424)	1.860*** (0.399)	−0.017 (0.140)
Percentage of Population with Bachelor's Degree	1.196*** (0.275)	1.624*** (0.257)	−0.273*** (0.085)
Median Income (Thousands of Dollars)	−0.049 (0.045)	−0.021 (0.045)	−0.036** (0.017)
Unemployment Rate	−0.090 (0.160)	0.005 (0.143)	−0.146** (0.068)
Percentage of Population that is White	0.190** (0.097)	0.184* (0.096)	−0.001 (0.030)
Personal Healthcare Spending per Capita (Thousands of Dollars)	2.997*** (0.503)	2.940*** (0.542)	0.241 (0.153)
Constant	−86.595*** (16.531)	−111.298*** (16.149)	5.971 (5.515)
Fixed Effects	Yes	Yes	Yes
Covariates	Yes	Yes	Yes
Observations	1,071	1,071	1,071
R ²	0.764	0.748	0.747
Adjusted R ²	0.746	0.729	0.727
Residual Std. Error	3.912 (df = 993)	3.710 (df = 993)	1.567 (df = 993)
F Statistic	41.724*** (df = 77; 993)	38.359*** (df = 77; 993)	38.039*** (df = 77; 993)

Note: