EDS241: Assignment 1

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Load data

Reading in the data and selecting the variables of interest

```
df <- read_csv(here("data", "CES4.csv")) %>%
  clean_names() %>%
  select(census_tract, total_population, california_county,
         low_birth_weight, pm2_5, poverty) %>%
  rename(pm25 = pm2_5)
```

(a) Average concentration of PM2.5 across all census tracts in California

```
avg_pm25 <- mean(df$pm25)
```

The average concentration of PM2.5 across all census tracts in California is 10.1526999 $\mu g/m^3$

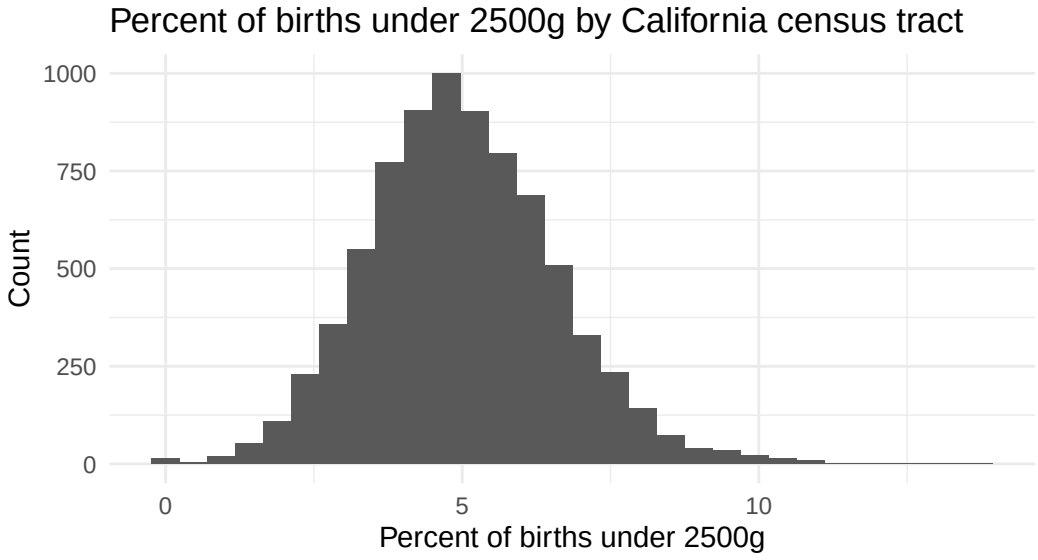
(b) County witht the highest level of poverty in California

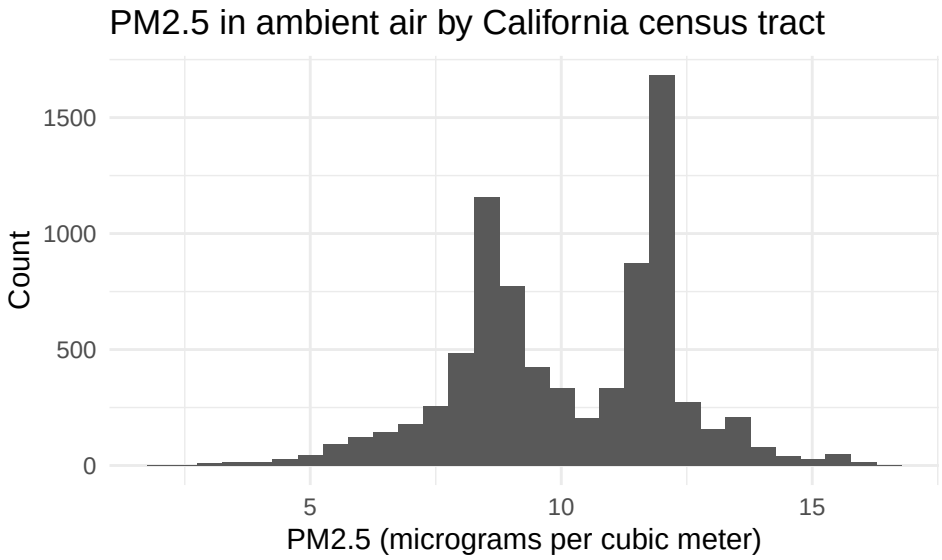
```
highest_poverty <- df %>%
  group_by(california_county) %>%
  mutate(tract_prop = total_population / sum(total_population)) %>%
  mutate(weighted_pov = tract_prop * poverty) %>%
  summarize("sum_weighted_pov" = sum(weighted_pov, na.rm = TRUE)) %>%
  filter(sum_weighted_pov == max(sum_weighted_pov))

highest_poverty_county <- highest_poverty$california_county
```

The county with the highest level of poverty is Tulare.

(c) Distributions of low birth weight and PM2.5

```r
lbw_plot <- ggplot(df, aes(x = low_birth_weight)) +
  geom_histogram() +
  theme_minimal() +
  labs(x = "Percent of births under 2500g", y = "Count",
       title = "Percent of births under 2500g by California census tract")

pm25_plot <- ggplot(df, aes(x = pm25)) +
  geom_histogram() +
  theme_minimal() +
  labs(x = "PM2.5 (micrograms per cubic meter)", y = "Count",
       title = "PM2.5 in ambient air by California census tract")
```





(d) OLS regression of low birth weight on PM2.5

```
model_pm25 <- lm_robust(low_birth_weight ~ pm25, df)
```

	term	estimate	std.error	statistic	p.value	conf.low	conf.high	df	outcome
1	(Intercept)	3.8010	0.0886	42.9088	0.0000	3.6273	3.9746	7806.0000	low_birth_weight
2	pm25	0.1179	0.0084	14.0354	0.0000	0.1015	0.1344	7806.0000	low_birth_weight

Table 1: Linear regression of percent low birth weight on PM2.5

The estimated slope coefficient is 0.1179305. This tells us that an increase of 1 $\mu g/m^3$ of PM2.5 in a given California census tract is associated with an estimated increase of 0.1179305 in the percentage of births in that tract with weight less than 2500g. The effect of PM2.5 on low birth weight *is* significant at the 5% level.

(f) Regression of low birth weight on PM2.5 and poverty

```
model_pm25_poverty <- lm_robust(low_birth_weight ~ pm25 + poverty, df)
```

	term	estimate	std.error	statistic	p.value	conf.low	conf.high	df	outcome
1	(Intercept)	3.5437	0.0847	41.8225	0.0000	3.3776	3.7098	7802.0000	low_birth_weight
2	pm25	0.0591	0.0083	7.1272	0.0000	0.0429	0.0754	7802.0000	low_birth_weight
3	poverty	0.0274	0.0010	27.3745	0.0000	0.0255	0.0294	7802.0000	low_birth_weight

Table 2: Multiple linear regression of percent low birth weight on PM2.5 and poverty

The estimated coefficient on poverty signifies that increasing the percentage of the population in the census tract living below twice the federal poverty line by 1% is associated with an estimated increase of 0.0274353 in low birth weight.

The estimated coefficient on PM2.5 decreased from 0.1179305 in our original single variable model, to 0.0591077 in our multivariate model. This is because PM2.5 and poverty are correlated (shown below)—and thus in our original model, the estimated coefficient on PM2.5 was attempting to explain some of the variation in low birth weight that our second model shows to be associated with poverty.

```
# showing correlation between pm25 and poverty
model_endogenous <- lm_robust(pm25 ~ poverty, df)
```

	term	estimate	std.error	statistic	p.value	conf.low	conf.high	df	outcome
1	(Intercept)	9.2566	0.0428	216.2251	0.0000	9.1727	9.3405	7958.0000	pm25
2	poverty	0.0286	0.0013	22.4739	0.0000	0.0261	0.0311	7958.0000	pm25

Table 3: Linear regression of PM2.5 on poverty

(g) Linear hypothesis test

```
lht <- linearHypothesis(model_pm25_poverty, "pm25=poverty", white.adjust = "hc2")
```

	Res.Df	Df	Chisq	Pr(>Chisq)
1	7803.0000			
2	7802.0000	1.0000	13.4682	0.0002

Table 4: Comparing effects of PM2.5 and poverty on percent low birth weight

Based on the results of our linear hypothesis test, we can reject the null hypothesis that the effects of PM2.5 and poverty on low birth weight are equal at the 0.1% level.