432 Homework 4 Answer Sketch and Grading Rubric

Due 2019-03-22. Version: 2019-03-15

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Setup and Data Ingest

```
library(ggrepel)
library(viridis)
library(broom); library(janitor); library(tidyverse)

ohc <- read_csv("oh_counties_2017.csv") %>%
    clean_names()
```

The `oh_counties_2017.csv` data set I have provided describes a series of variables, pulled from the data for the 88 counties of the the State of Ohio from the County Health Rankings report for 2017.

- You may also be interested in looking at the details of the 2017 Ohio Summary report (pdf), or at the Excel data file from which I created the `oh_counties_2017.csv` file.
- Note that the 2018 data and report were released recently, but we will concentrate in this assignment on the 2017 results.

The available variables are listed below. Each variable describes data at the **COUNTY** level.

Variable	Description
fips	Federal Information Processing Standard code
county	name of County
years_lost_rate	age-adjusted years of potential life lost rate (per 100,000 population)
sroh_fairpoor	% of adults reporting fair or poor health (via BRFSS)
phys_days	mean number of reported physically unhealthy days per month
ment_days	mean number of reported mentally unhealthy days per mo
lbw_pct	% of births with low birth weight (< 2500 grams)
smoker_pct	% of adults that report currently smoking

Variable	Description
obese_pct	% of adults that report body mass index of 30 or higher
food_env	indicator of access to healthy foods, in points (0 is worst, 10 is best)
inactive_pct	% of adults that report no leisure-time physical activity
exer_access	% of the population with access to places for physical activity
exc_drink	% of adults that report excessive drinking
alc_drive	% of driving deaths with alcohol involvement
sti_rate	Chlamydia cases / Population x 100,000
teen_births	Teen births / females ages 15-19 x 1,000
uninsured	% of people under age 65 without insurance
pcp_ratio	Population to Primary Care Physicians ratio
prev_hosp	Discharges for Ambulatory Care Sensitive Conditions/Medicare Enrollees x 1,000
hsgrads	High School graduation rate
unemployed	% of population age 16+ who are unemployed and looking for work
poor_kids	% of children (under age 18) living in poverty
income_ratio	Ratio of household income at the 80th percentile to income at the 20th percentile
associations	# of social associations / population x 10,000
pm2.5	Average daily amount of fine particulate matter in micrograms per cubic meter
h2oviol	Presence of a water violation: Yes or No
sev_housing	% of households with at least 1 of 4 housing problems: overcrowding, high housing costs, or lack of kitchen or plumbing facilities
drive_alone	% of workers who drive alone to work
age.adj.mortality	premature age-adjusted mortality
dm_prev	% with a diabetes diagnosis
freq_phys_distress	% in frequent physical distress
freq_mental_distress	% in frequent mental distress
food_insecure	% who are food insecure
insuff_sleep	% who get insufficient sleep
health_costs	estimated mean health care costs
median_income	estimated median income
population	population size
age65plus	% of population who are 65 and over
african-am	% of population who are African-American
hispanic	% of population who are of Hispanic/Latino ethnicity
white	% of population who are White
female	% of population who are Female
rural	% of people in the county who live in rural areas

1 Question 1 (15 points)

Create a visualization (using R) based on some part of the `oh_counties_2017.csv` data set, and share it (the visualization and the R code you used to build it) with us. The visualization should be of a professional quality, describe information from at least three different variables listed above, include proper labels and a title, as well as a caption of no more than 50 words that highlights the key result. Although you may fit a model to help show patterns, your primary task is to show **the data** in a meaningful way, rather than to simply highlight the results of a model.

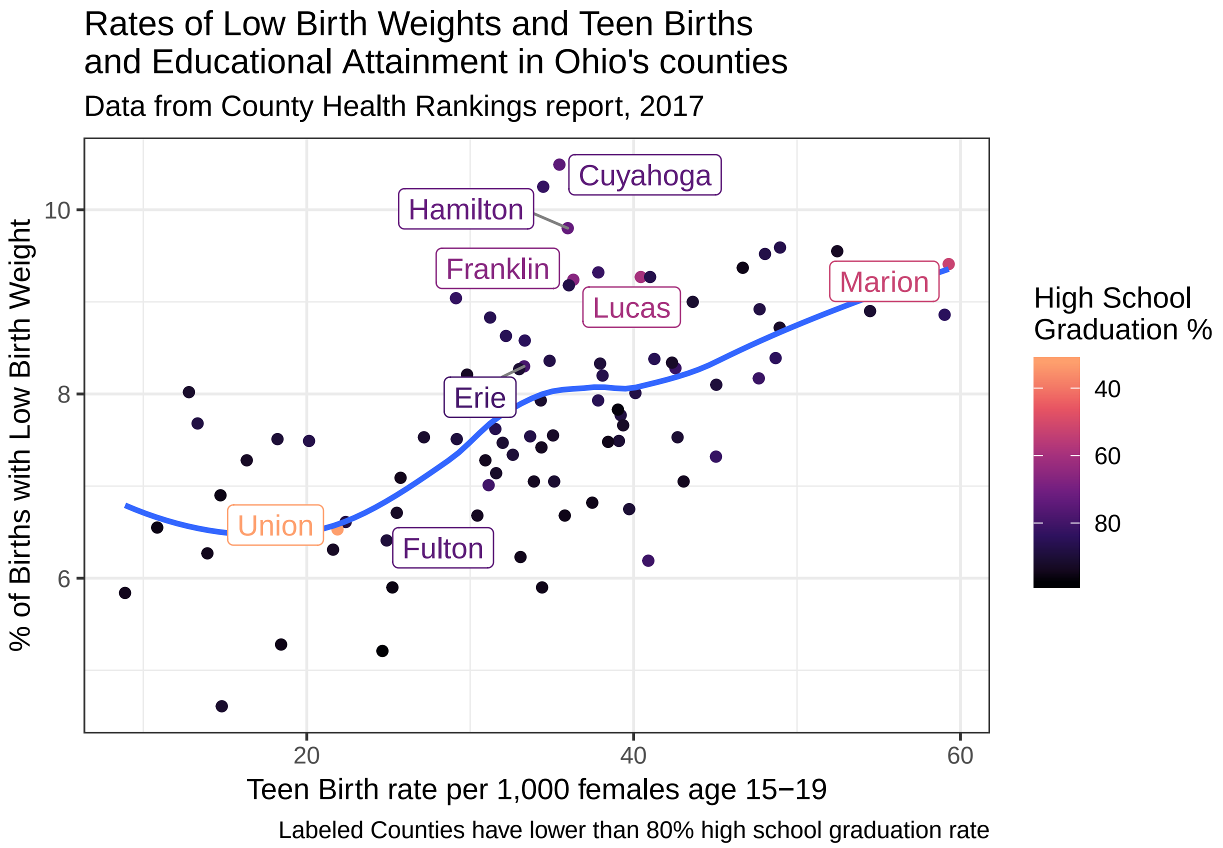
- You are welcome to find useful tools for visualizing data in R that we have yet to see in the slides in class.
- We will grade Question 1 strictly based on the quality of the visualization, its title and caption, in terms of being attractive, well-labeled and useful for representing the County Health Rankings data for Ohio, and how well it adheres to general principles for good visualizations we've seen in 431 and 432.

1.1 Answer for Question 1

There are, literally, thousands of appropriate options here, so it's difficult to write a sketch. Of course, that statement is true for all of these questions.

What Dr. Love assumed most people would do is some sort of labeled scatterplot. Here's an example.

```
ggplot(ohc, aes(x = teen_births, y = lbw_pct,
                col= hsgrads))  +
    geom_point() +
    geom_smooth(method = "loess", se = FALSE) +
    geom_label_repel(aes(
        label=ifelse(hsgrads<80, as.character(county),'')),
        segment.color = 'grey50') +
    theme_bw() +
    scale_color_viridis_c(end = 0.8, option = "magma",
        (name="High School \nGraduation %"),
        trans = "reverse") +
    labs(
        title = "Rates of Low Birth Weights and Teen Births\nand Educational Attainment in Ohio's count
        subtitle = "Data from County Health Rankings report, 2017",
        caption="Labeled Counties have lower than 80% high school graduation rate",
        y = "% of Births with Low Birth Weight",
        x = "Teen Birth rate per 1,000 females age 15-19")
```



Some people built maps, as well. That's great, but it's hard to show more than one variable at a time on a map of Ohio's counties. Dr. Love will share some of the plots we found to be most effective in class.

1.2 Grading Rubric: Question 1

- Award 12 points for a good effort and 13-15 points for an especially strong effort (one of the top 5-8 visualizations we saw).
- Anything that seems way off the mark should get 10 or less, and should be drawn to my attention, as should the graphs that get 13-15 points.
- Take off 1 point from the total if you find one or two typographical or syntax/grammar errors in this response.
- Take off 2 points from the total if you find three or more such errors.

I expect most people to score 11-13 points on this question.

2 Question 2 (15 points)

Write an essay (between 100 and 200 words) describing the creation and meaning of the visualization you created in Question 1, providing us with the context we need to understand why this is a useful visualization. In your short description, be sure to address:

- How does this visualization help its audience understand the data better?
- Why is this particular visualization effective, and what are the design features it uses that we can learn from to help us make more effective visualizations?

2.1 Answer 2

We don't write sketches for essay questions, but the takeaway from the labeled scatterplot provided above should draw attention to:

- the general pattern (% of low birth weight births generally rises with the teen birth rate) displayed,
- other features of the data (outlying counties at the high end also generally have lower educational attainment),
- plus identify the outliers (Union County, in terms of HS Graduation Rate, but also Cuyahoga in terms of low birth weight and Marion, in terms of high teen birth rate.)

2.2 Grading Rubric: Question 2

- Award 13 points for any essay that is within the word limit (or close) and answers the two questions reasonably well.
- Award 14-15 points for an essay that does a really nice job.
- Award 10 or fewer points to anything that doesn't address both questions, or is way off the mark.
- Take off 1 point from the total if you find one or two typographical or syntax/grammar errors in this response.
- Take off 2 points from the total if you find three or more such errors.

Almost all of the essays will thus score 12-14 points on this question, I'd guess.

3 Question 3 (10 points)

Create a linear regression model to predict `obese_pct` as a function of `food_env` adjusting for `median_income`, and treating all three variables as quantitative, using all counties with complete data on those three variables. Specify and then carefully interpret the estimated coefficient of `food_env` and a 90% confidence interval around that estimate in context using nothing but complete English sentences. A model using main effects only, entered as linear predictors, will be sufficient.

3.1 Answer 3

The model we had in mind was

```
model3 <- lm(obese_pct ~ food_env + median_income, data = ohc)

tidy(model3, conf.int = TRUE, conf.level = 0.90)
```

```
# A tibble: 3 x 7
  term           estimate std.error statistic  p.value   conf.low conf.high
  <chr>             <dbl>     <dbl>     <dbl>    <dbl>      <dbl>     <dbl>
1 (Intercept)   32.8      3.17          10.4  1.00e-16  27.5         3.81e+1
2 food_env       1.14     0.547          2.09 3.99e- 2   0.232       2.05e+0
3 median_inco~  -0.000166 0.0000363     -4.57 1.66e- 5  -0.000226   -1.05e-4
```

- The value of the estimated effect of a change of 1 point in `food_env` is an increase of 1.14 percentage points in `obese_pct`, with a 90% CI of (0.23, 2.05), assuming `median_income` is unchanged.

3.2 Grading Rubric: Question 3

- Estimating the result correctly is worth 3 points.
- The other seven points are awarded if the student has an excellent description of the effect size. That description should:
  - describe a comparison between two *counties*, with the *same median income*, who differ by 1 *point* in `food_env` and come to a conclusion about the *size* and the *direction* of the effect on `obese_pct`, while using *appropriate units* for `food_env` and `obese_pct` and indicating the *statistical significance* of the result at the *10% significance level* (or *90% confidence level*) with reference to the confidence interval.
  - the seven key elements are:
    1. this model describes counties, not subjects/individuals/whatever
    2. holding the same median income
    3. comparison of two counties with differing food environments with the correct units for the food environment measure
    4. description of effect on an outcome with the correct units for the outcome
    5. size of effect specified to match their model
    6. direction of effect specified to match their model
    7. significance of effect and level of confidence/significance
- Showing the effect graphically is a nice, but ungraded, touch.

4 Question 4 (10 points)

Create a logistic regression model to predict the presence of a water violation (as contained in `h2oviol`) on the basis of `sev_housing` and `pm2.5`. Specify and then carefully interpret the estimated coefficient of `sev_housing` and a 90% confidence interval around that estimate in context using nothing but complete English sentences. A model using main effects only, entered as linear predictors, will be sufficient.

4.1 Answer 4

The model we had in mind was

```
model4 <- glm(h2oviol == "Yes" ~ sev_housing + pm2_5, data = ohc, family = binomial())

tidy(model4, conf.int = TRUE, conf.level = 0.90, exponentiate = TRUE)
```

```
# A tibble: 3 x 7
  term        estimate std.error statistic p.value    conf.low conf.high
  <chr>          <dbl>     <dbl>     <dbl>   <dbl>       <dbl>     <dbl>
1 (Intercept)  0.00303    5.36      -1.08    0.280 0.000000311     17.5
2 sev_housing  1.03       0.0869     0.300   0.764 0.889            1.19
3 pm2_5        1.60       0.467      1.01    0.313 0.752            3.55
```

- The value of the estimated effect of a change of 1 percentage point in `sev_housing` is an increase by a factor of 1.026 in the odds of a water violation, with a 90% CI of (0.89, 1.19), assuming `pm2_5` is unchanged.

4.2 Grading Rubric: Question 4

- Estimating the result correctly is worth 3 points.
- The other seven points are awarded if the student has an excellent description of the effect size. That description should:
  - describe a comparison between two *counties*, with the *same pm2_5*, who differ by 1 *percentage point* in `sev_housing` and come to a conclusion about the *size* and the *direction* of the effect on `h2oviol` in terms of an odds ratio, while using *appropriate units* for all variables, referring to odds changes, rather than changes in risk or probability and indicating the *statistical significance* of the result at the *10% significance level* (or *90% confidence level*) with reference to the confidence interval.
  - the seven key elements are:
    1. this model describes counties, not subjects/individuals/whatever
    2. holding the same pm2.5 or pm2_5 (depending on whether they cleaned the names)
    3. comparison of two counties with differing percentages meeting the `sev_housing` standard
    4. description of effect on the `h2oviol` odds
    5. size of effect specified to match their model
    6. direction of effect specified to match their model (which should be about the odds of having a violation)
    7. (lack of) significance of effect and level of confidence/significance
- Showing the effect graphically is a nice, but ungraded, touch.

Session Information

```
sessioninfo::session_info()
```

```
- Session info ----------------------------------------------------------
 setting  value
 version  R version 3.5.3 (2019-03-11)
 os       Windows 10 x64
 system   x86_64, mingw32
 ui       RTerm
 language (EN)
 collate  English_United States.1252
 ctype    English_United States.1252
 tz       America/New_York
 date     2019-03-15

- Packages --------------------------------------------------------------
 package     * version  date       lib source
 assertthat    0.2.0    2017-04-11 [1] CRAN (R 3.5.0)
 backports     1.1.3    2018-12-14 [1] CRAN (R 3.5.2)
 broom       * 0.5.1    2018-12-05 [1] CRAN (R 3.5.2)
 cellranger    1.1.0    2016-07-27 [1] CRAN (R 3.5.0)
 cli           1.0.1    2018-09-25 [1] CRAN (R 3.5.1)
 colorspace    1.4-0    2019-01-13 [1] CRAN (R 3.5.2)
 crayon        1.3.4    2017-09-16 [1] CRAN (R 3.5.0)
 digest        0.6.18   2018-10-10 [1] CRAN (R 3.5.1)
 dplyr       * 0.8.0.1  2019-02-15 [1] CRAN (R 3.5.3)
 evaluate      0.13     2019-02-12 [1] CRAN (R 3.5.3)
 fansi         0.4.0    2018-10-05 [1] CRAN (R 3.5.1)
 forcats     * 0.4.0    2019-02-17 [1] CRAN (R 3.5.3)
 generics      0.0.2    2018-11-29 [1] CRAN (R 3.5.1)
 ggplot2     * 3.1.0    2018-10-25 [1] CRAN (R 3.5.1)
 ggrepel     * 0.8.0    2018-05-09 [1] CRAN (R 3.5.2)
 glue          1.3.1    2019-03-12 [1] CRAN (R 3.5.3)
 gridExtra     2.3      2017-09-09 [1] CRAN (R 3.5.2)
 gtable        0.2.0    2016-02-26 [1] CRAN (R 3.5.0)
 haven         2.1.0    2019-02-19 [1] CRAN (R 3.5.3)
 hms           0.4.2    2018-03-10 [1] CRAN (R 3.5.0)
 htmltools     0.3.6    2017-04-28 [1] CRAN (R 3.5.0)
 httr          1.4.0    2018-12-11 [1] CRAN (R 3.5.2)
 janitor     * 1.1.1    2018-07-31 [1] CRAN (R 3.5.1)
 jsonlite      1.6      2018-12-07 [1] CRAN (R 3.5.2)
 knitr         1.22     2019-03-08 [1] CRAN (R 3.5.3)
 labeling      0.3      2014-08-23 [1] CRAN (R 3.5.0)
 lattice       0.20-38  2018-11-04 [1] CRAN (R 3.5.2)
 lazyeval      0.2.1    2017-10-29 [1] CRAN (R 3.5.0)
 lubridate     1.7.4    2018-04-11 [1] CRAN (R 3.5.0)
 magrittr      1.5      2014-11-22 [1] CRAN (R 3.5.2)
 MASS          7.3-51.1 2018-11-01 [1] CRAN (R 3.5.2)
 modelr        0.1.4    2019-02-18 [1] CRAN (R 3.5.3)
 munsell       0.5.0    2018-06-12 [1] CRAN (R 3.5.0)
 nlme          3.1-137  2018-04-07 [2] CRAN (R 3.5.3)
 pillar        1.3.1    2018-12-15 [1] CRAN (R 3.5.2)
 pkgconfig     2.0.2    2018-08-16 [1] CRAN (R 3.5.1)
 plyr          1.8.4    2016-06-08 [1] CRAN (R 3.5.0)
 purrr       * 0.3.1    2019-03-03 [1] CRAN (R 3.5.3)
 R6            2.4.0    2019-02-14 [1] CRAN (R 3.5.3)
 Rcpp          1.0.0    2018-11-07 [1] CRAN (R 3.5.1)
 readr       * 1.3.1    2018-12-21 [1] CRAN (R 3.5.2)
 readxl        1.3.1    2019-03-13 [1] CRAN (R 3.5.3)
 rlang         0.3.1    2019-01-08 [1] CRAN (R 3.5.2)
 rmarkdown     1.12     2019-03-14 [1] CRAN (R 3.5.3)
 rstudioapi    0.9.0    2019-01-09 [1] CRAN (R 3.5.2)
 rvest         0.3.2    2016-06-17 [1] CRAN (R 3.5.0)
 scales        1.0.0    2018-08-09 [1] CRAN (R 3.5.1)
 sessioninfo   1.1.1    2018-11-05 [1] CRAN (R 3.5.1)
 snakecase     0.9.2    2018-08-14 [1] CRAN (R 3.5.1)
 stringi       1.4.3    2019-03-12 [1] CRAN (R 3.5.3)
 stringr     * 1.4.0    2019-02-10 [1] CRAN (R 3.5.3)
 tibble      * 2.0.1    2019-01-12 [1] CRAN (R 3.5.2)
 tidyr       * 0.8.3    2019-03-01 [1] CRAN (R 3.5.3)
 tidyselect    0.2.5    2018-10-11 [1] CRAN (R 3.5.1)
 tidyverse   * 1.2.1    2017-11-14 [1] CRAN (R 3.5.2)
 utf8          1.1.4    2018-05-24 [1] CRAN (R 3.5.0)
 viridis     * 0.5.1    2018-03-29 [1] CRAN (R 3.5.2)
 viridisLite * 0.3.0    2018-02-01 [1] CRAN (R 3.5.0)
 withr         2.1.2    2018-03-15 [1] CRAN (R 3.5.0)
 xfun          0.5      2019-02-20 [1] CRAN (R 3.5.3)
 xml2          1.2.0    2018-01-24 [1] CRAN (R 3.5.0)
 yaml          2.2.0    2018-07-25 [1] CRAN (R 3.5.1)

[1] C:/Users/Thomas/Documents/R/win-library/3.5
[2] C:/Program Files/R/R-3.5.3/library
```