# WU #3 - Inference on beta_1

Math 158 - Jo Hardin

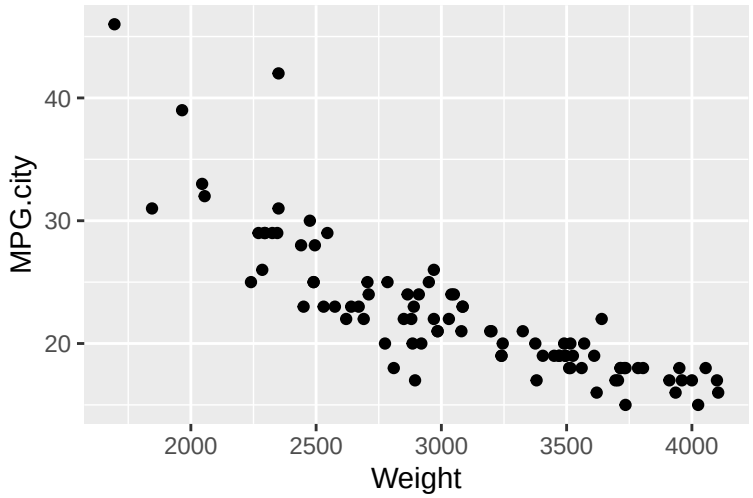
in class: Tuesday 1/25/2022, due: Wednesday 1/26/2022

Name: _____

Names of people you worked with: _____

Consider the following linear model output. The data are based on a random sample of cars from among 1993 passenger car models that were listed in both *Consumer Reports* and the *PACE Buying Guide*. We are considering the variables `weight` and `MPG.city`.

```
Cars93 %>%
  ggplot(aes(y=MPG.city, x= Weight)) +
  geom_point()
```




```
Cars93 %>%
  lm(MPG.city ~ Weight, data = .) %>%
  tidy() %>%
  dplyr::select(term, estimate, std.error)
```

```
## # A tibble: 2 x 3
##   term        estimate std.error
##   <chr>          <dbl>     <dbl>
## 1 (Intercept) 47.0      1.68
## 2 Weight      -0.00803  0.000537
```

1. Find the $T$ test statistic and (approximate) p-value for the test $H_0 : \beta_1 = 0$.
2. Roughly approximate a 95% CI for the true $\beta_1$.

note: There are 93 observations, but for the warm-up use rough approximations where the sample size doesn't play a role.

**Solution:**

1. p-value is virtually zero.

$$T = \frac{b_1 - 0}{se(b_1)} = \frac{-0.008}{0.000537} = -14.96$$

```
Cars93 %>%
  lm(MPG.city ~ Weight, data = .) %>%
  tidy()
```

```
## # A tibble: 2 x 5
##   term        estimate std.error statistic  p.value
##   <chr>          <dbl>     <dbl>     <dbl>    <dbl>
## 1 (Intercept) 47.0      1.68          28.0 1.63e-46
## 2 Weight      -0.00803  0.000537     -15.0 2.97e-26
```

2. We are 95% confident that the true slope is between roughly -0.0091 to -0.0069 MPG per pound of car.

$$b_1 \pm t^*_{1-\alpha/2, n-2} \cdot se(b_1) \approx -0.008 \pm 2 \cdot 0.000547$$

```
Cars93 %>%
  lm(MPG.city ~ Weight, data = .) %>%
  tidy(conf.int = TRUE, conf.level = 0.95) %>%
  dplyr::select(term, conf.low, conf.high)
```

```
## # A tibble: 2 x 3
##   term        conf.low conf.high
##   <chr>          <dbl>     <dbl>
## 1 (Intercept) 43.7      50.4
## 2 Weight      -0.00910  -0.00697
```