Problem Set 3

QTM 200: Applied Regression Analysis

Due: February 17, 2020

Instructions

- Please show your work! You may lose points by simply writing in the answer. If the problem requires you to execute commands in `R`, please include the code you used to get your answers. Please also include the `.R` file that contains your code. If you are not sure if work needs to be shown for a particular problem, please ask.
- Your homework should be submitted electronically on the course GitHub page in `.pdf` form.
- This problem set is due at the beginning of class on Monday, February 17, 2020. No late assignments will be accepted.
- Total available points for this homework is 100.

In this problem set, you will run several regressions and create an add variable plot (see the lecture slides) in `R` using the `incumbents_subset.csv` dataset. Include all of your code.

Question 1 (20 points)

We are interested in knowing how the difference in campaign spending between incumbent and challenger affects the incumbent's vote share.

1. Run a regression where the outcome variable is `voteshare` and the explanatory variable is `difflog`.

```
incumbents_subset <- read_csv("GitHub/QTM200Spring2020/problem_sets/PS3/
    incumbents_subset.csv")

fitmodel <- lm(voteshare ~ difflog, data=incumbents_subset)
summary(fitmodel)
```

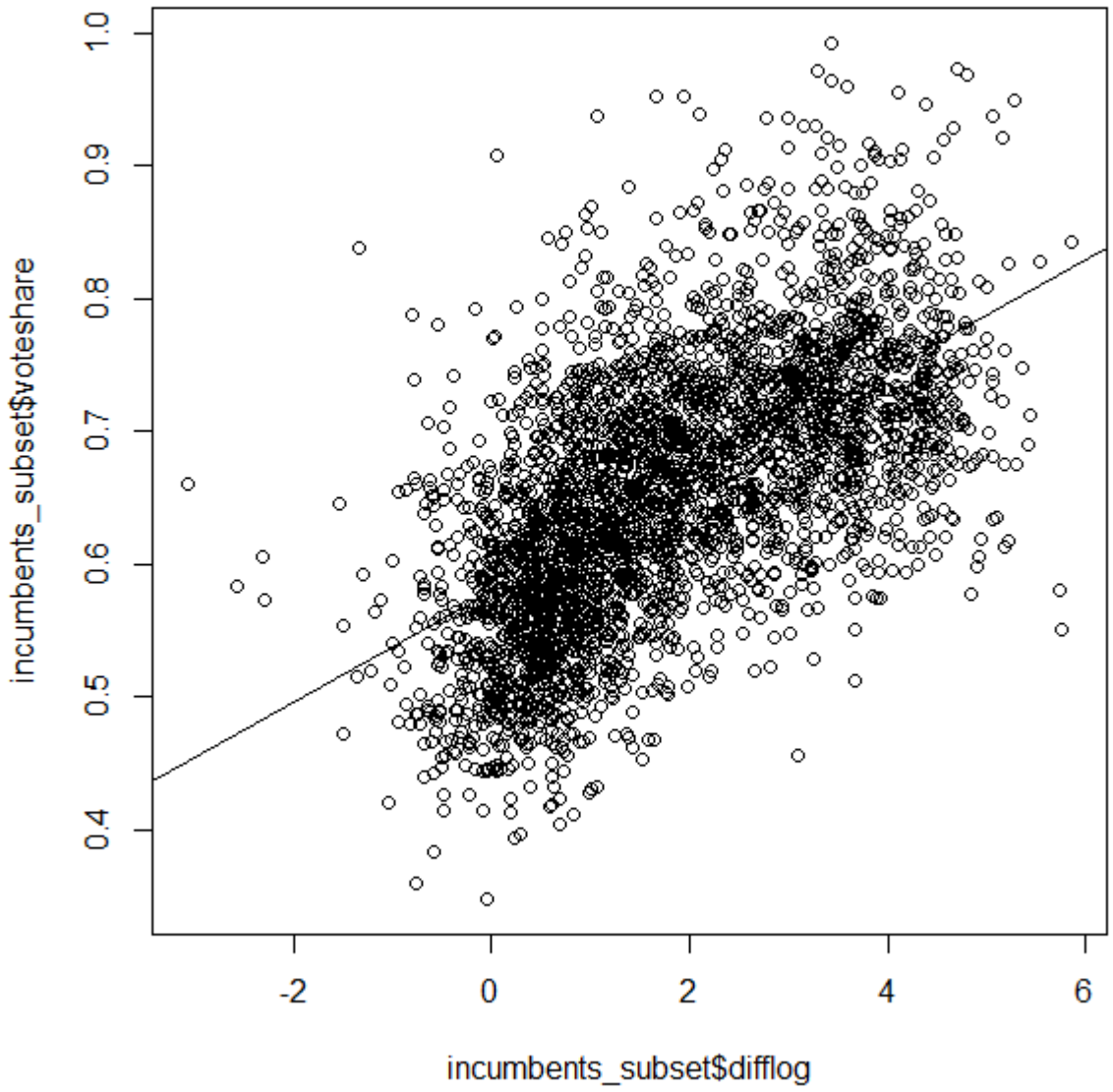
```
Residuals:
Min       1Q   Median       3Q      Max
-0.26832 -0.05345 -0.00377  0.04780  0.32749

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.579031   0.002251  257.19   <2e-16 ***
difflog     0.041666   0.000968   43.04   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.07867 on 3191 degrees of freedom
Multiple R-squared:  0.3673,Adjusted R-squared:  0.3671
F-statistic:  1853 on 1 and 3191 DF,  p-value: < 2.2e-16
```

2. Make a scatterplot of the two variables and add the regression line.

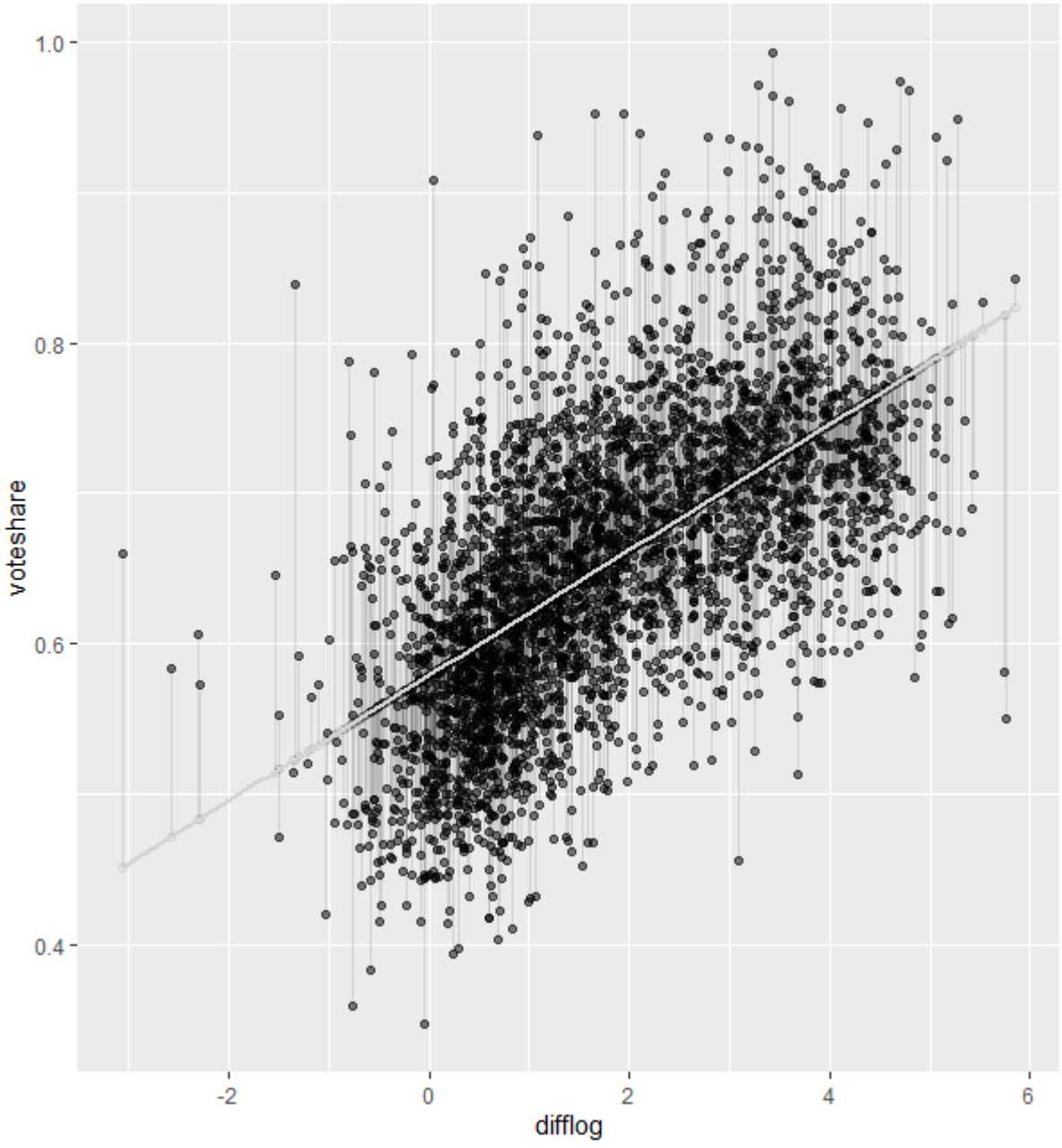
```r
plot(incumbents_subset$voteshare ~ incumbents_subset$difflog)
fitmodel
abline(fitmodel)
```



3. Save the residuals of the model in a separate object.

```r
incumbents_subset$predicted <- predict(fitmodel)
incumbents_subset$residuals1 <- residuals(fitmodel)

plot_residuals <- ggplot(incumbents_subset, aes(x=difflog, y=voteshare))+
  geom_point(alpha = I(0.5))+
  geom_point(aes(y= predicted), shape =1, alpha = I(0.1))+
  geom_segment(aes(xend = difflog, yend = predicted), alpha=I(0.1))+
  geom_smooth(method="lm", se=F, color = "lightgrey")
plot_residuals
```



4. Write the prediction equation.

   $y = 0.04167x + 0.579$

Question 2 (20 points)

We are interested in knowing how the difference between incumbent and challenger's spending and the vote share of the presidential candidate of the incumbent's party are related.

1. Run a regression where the outcome variable is `presvote` and the explanatory variable is `difflog`.

```
fitmodel2 <- lm(presvote~difflog , data = incumbents_subset)
summary(fitmodel2)
```

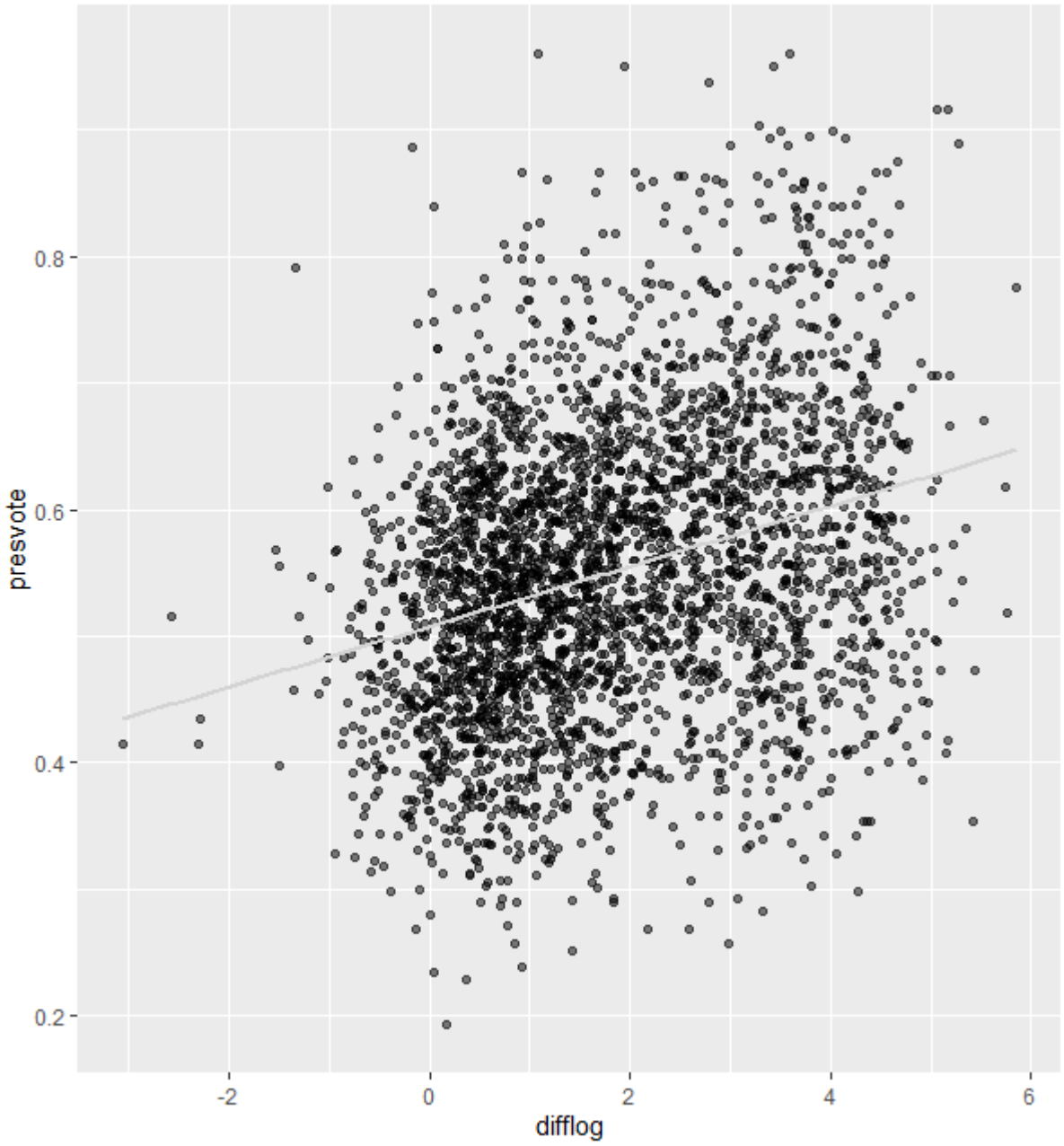
```
Residuals:
Min       1Q   Median       3Q      Max
-0.32196 -0.07407 -0.00102  0.07151  0.42743

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.507583   0.003161  160.60   <2e-16 ***
difflog     0.023837   0.001359   17.54   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1104 on 3191 degrees of freedom
Multiple R-squared:  0.08795,Adjusted R-squared:  0.08767
F-statistic: 307.7 on 1 and 3191 DF,  p-value: < 2.2e-16
```

2. Make a scatterplot of the two variables and add the regression line.

```
plot2<- ggplot(incumbents_subset , aes(x=difflog , y=presvote))+
  geom_point(alpha=I(0.5))+
  geom_smooth(method = "lm", se = F, color = "lightgrey")
plot2
```

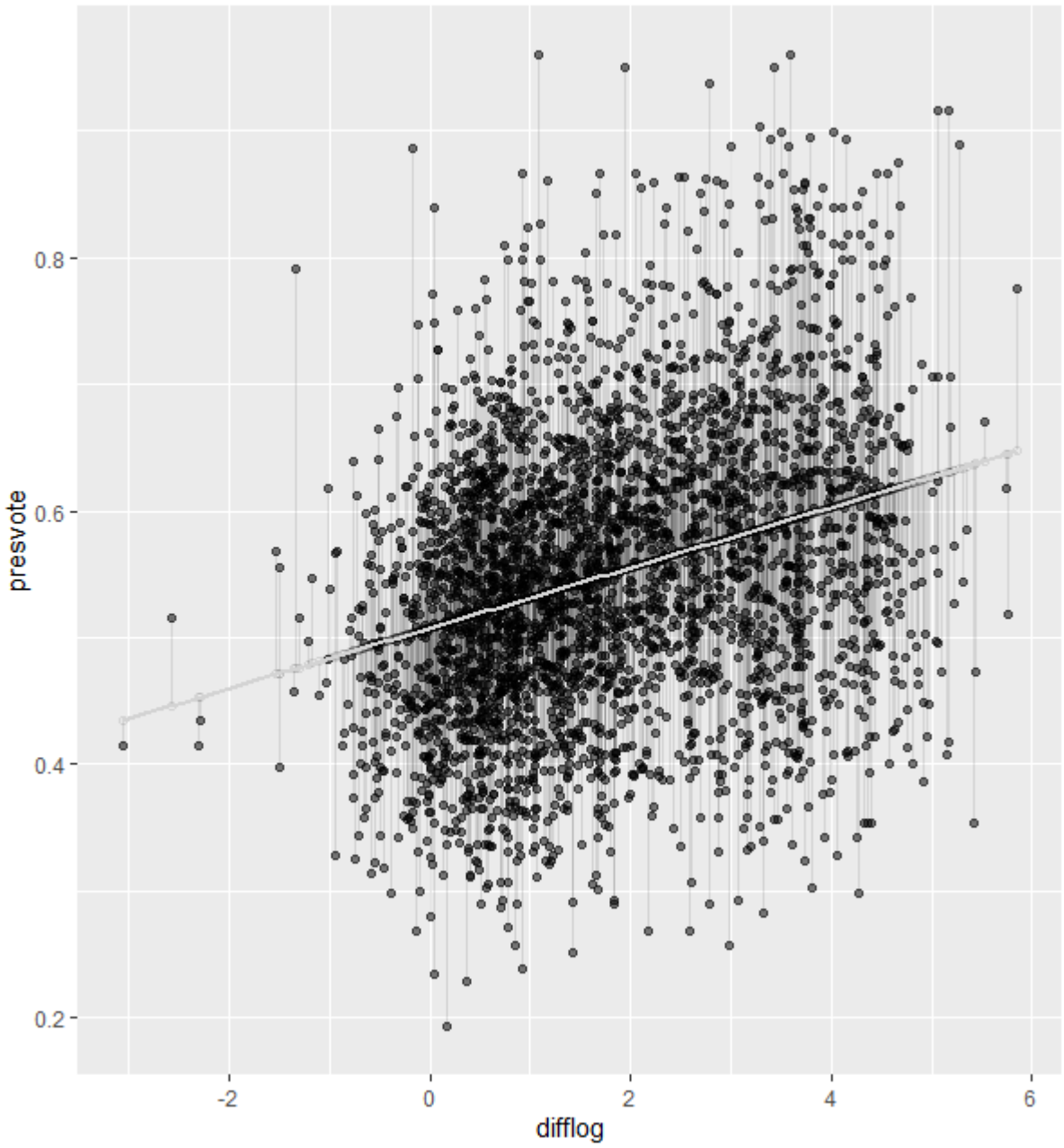


3. Save the residuals of the model in a separate object.

```
incumbents_subset$prediction <- predict(fitmodel2)
incumbents_subset$residuals2 <- residuals(fitmodel2)

```

```
plot2_residuals <-ggplot(incumbents_subset, aes(x=difflog, y=presvote))+
  geom_point(alpha = I(0.5))+
  geom_point(aes(y= prediction), shape =1, alpha = I(0.1))+
  geom_segment(aes(xend = difflog, yend = prediction), alpha=I(0.1))+
  geom_smooth(method="lm", se=F, color = "lightgrey")
plot2_residuals
```



4. Write the prediction equation.

   $y = 0.0238x + 0.508$

Question 3 (20 points)

We are interested in knowing how the vote share of the presidential candidate of the incumbent's party is associated with the incumbent's electoral success.

1. Run a regression where the outcome variable is `voteshare` and the explanatory variable is `presvote`.

```
fitmodel3 <- lm(voteshare ~ presvote, data=incumbents_subset)
summary(fitmodel3)
```

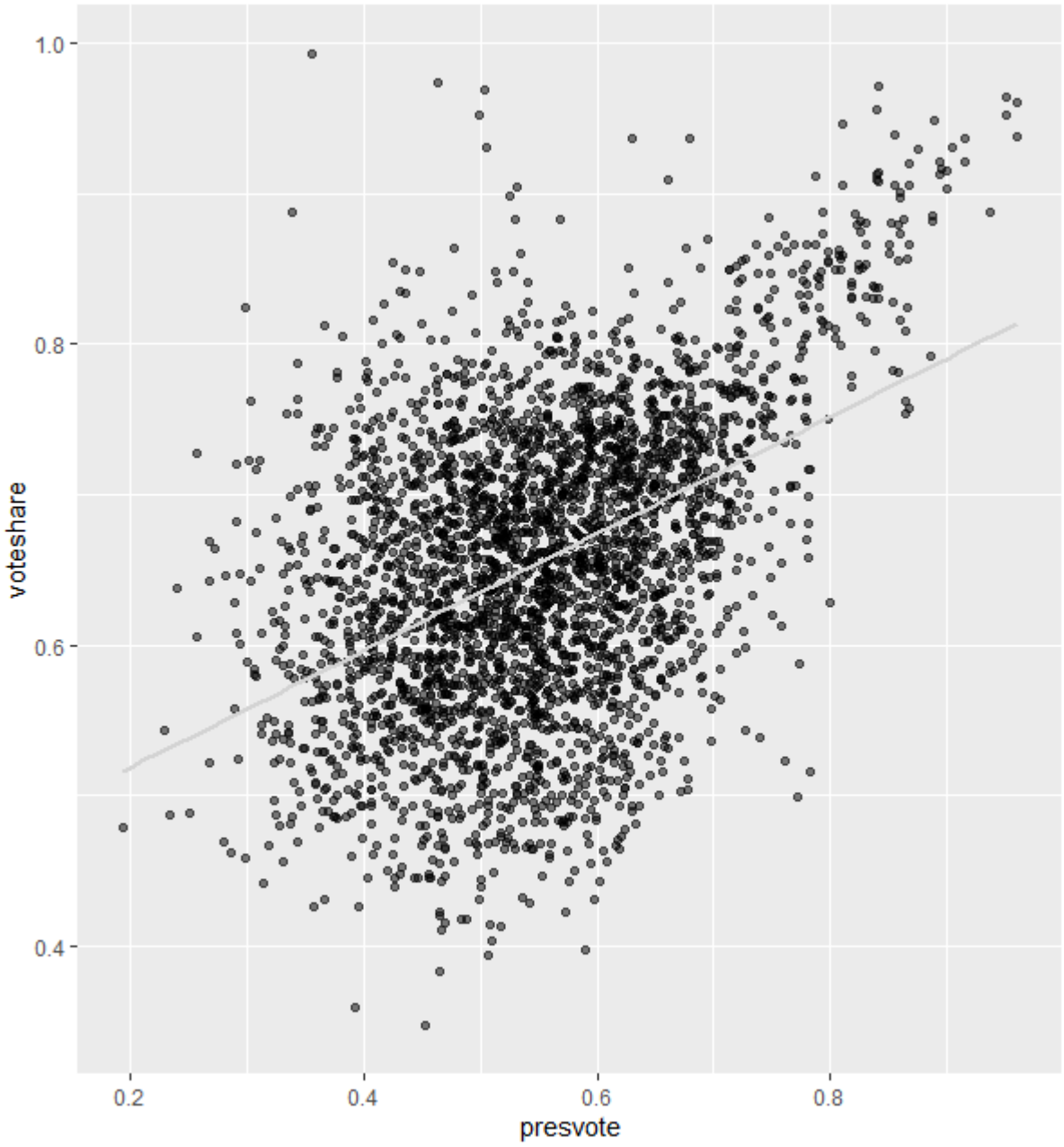
```
Residuals:
Min       1Q   Median       3Q      Max
-0.27330 -0.05888  0.00394  0.06148  0.41365

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.441330   0.007599   58.08   <2e-16 ***
presvote    0.388018   0.013493   28.76   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.08815 on 3191 degrees of freedom
Multiple R-squared:  0.2058,Adjusted R-squared:  0.2056
F-statistic:   827 on 1 and 3191 DF,  p-value: < 2.2e-16
```

2. Make a scatterplot of the two variables and add the regression line.

```
plot3<- ggplot(incumbents_subset, aes(x=presvote, y=voteshare))+
  geom_point(alpha=I(0.5))+
  geom_smooth(method = "lm", se=F, color = "lightgrey")
plot3
```


1.0
0.8
0.6
0.4
voteshare
0.2
0.4
0.6
0.8
presvote

3. Write the prediction equation.

   $y = 0.388x + 0.441$

Question 4 (20 points)

The residuals from part (a) tell us how much of the variation in `voteshare` is *not* explained by the difference in spending between incumbent and challenger. The residuals in part (b) tell us how much of the variation in `presvote` is *not* explained by the difference in spending between incumbent and challenger in the district.

1. Run a regression where the outcome variable is the residuals from Question 1 and the explanatory variable is the residuals from Question 2.

```
fitmodel4 <- lm(residuals1 ~ residuals2, data = incumbents_subset)
summary(fitmodel4)
```

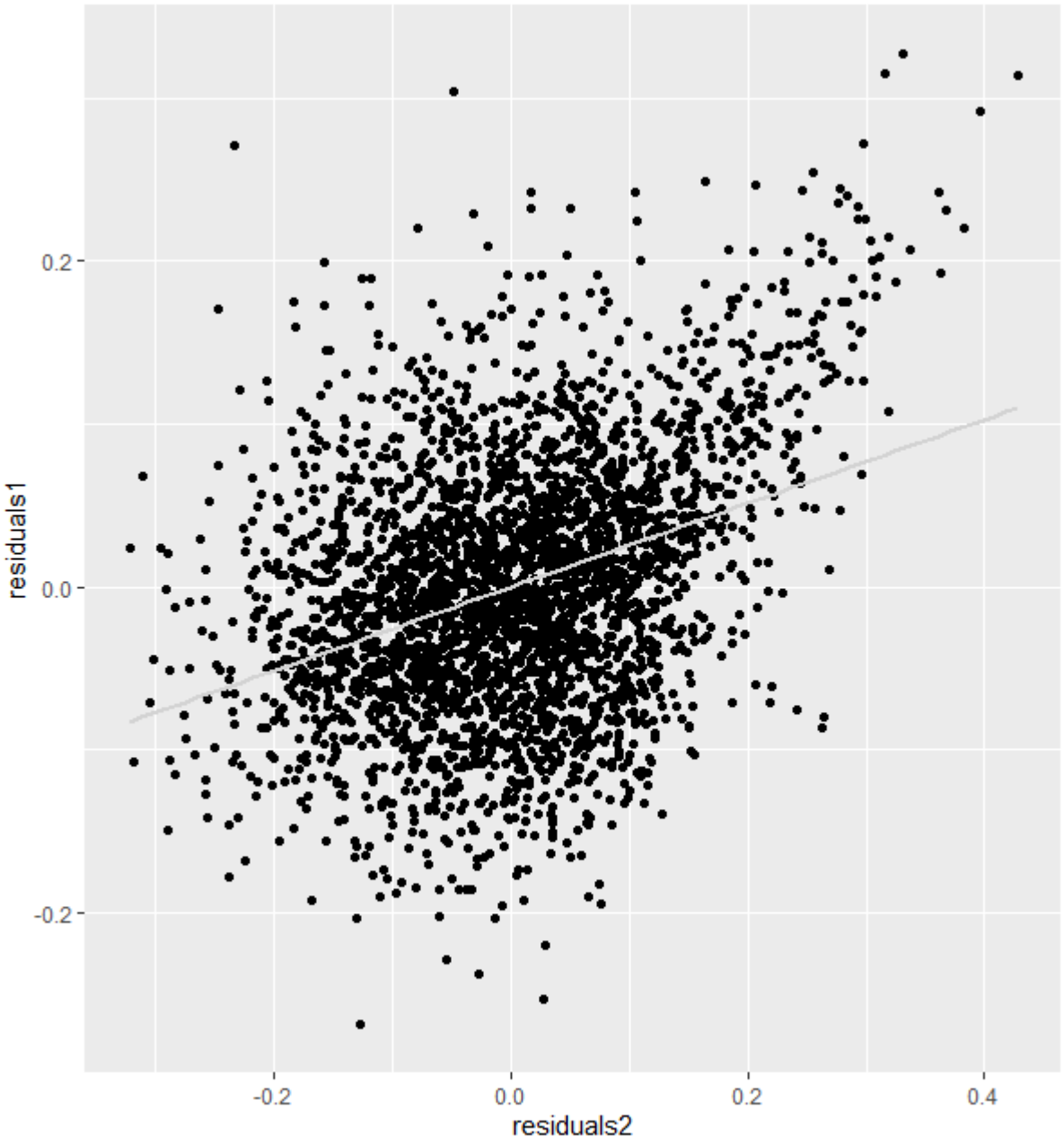
```
Residuals:
Min       1Q   Median       3Q      Max
-0.25928 -0.04737 -0.00121  0.04618  0.33126

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) -4.860e-18  1.299e-03    0.00        1
residuals2   2.569e-01  1.176e-02   21.84   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.07338 on 3191 degrees of freedom
Multiple R-squared:   0.13,Adjusted R-squared:  0.1298
F-statistic:   477 on 1 and 3191 DF,  p-value: < 2.2e-16
```

2. Make a scatterplot of the two residuals and add the regression line.

```
plot4 <- ggplot(incumbents_subset, aes(x=residuals2, y=residuals1))+
  geom_point()+
  geom_smooth(method = "lm", se=F, color = "lightgrey")
plot4
```



3. Write the prediction equation.

   $y = -4.86 * 10^{-18}x + 0.257$

Question 5 (20 points)

What if the incumbent's vote share is affected by both the president's popularity and the difference in spending between incumbent and challenger?

1. Run a regression where the outcome variable is the incumbent's `voteshare` and the explanatory variables are `difflog` and `presvote`.

```
multiplefit<- lm(voteshare~difflog+presvote, data = incumbents_subset)
summary(multiplefit)
```

```
Residuals:
Min       1Q   Median       3Q      Max
-0.25928 -0.04737 -0.00121  0.04618  0.33126

Coefficients:
Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.4486442  0.0063297   70.88   <2e-16 ***
difflog     0.0355431  0.0009455   37.59   <2e-16 ***
presvote    0.2568770  0.0117637   21.84   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.07339 on 3190 degrees of freedom
Multiple R-squared:  0.4496,Adjusted R-squared:  0.4493
F-statistic:  1303 on 2 and 3190 DF,  p-value: < 2.2e-16
```

2. Write the prediction equation.

   $y = 0.0355x_1 + 0.2569x_2 + 0.4486$

3. What is it in this output that is identical to the output in Question 4? Why do you think this is the case?

   The p-values are identical to the output of Question 4, illustrating that the significance of the two plots are identical to each other.