

Welcome!

All TF materials are available at github.com/nolankav/api-202.

If you want to follow along, download the dataset here:

In R: `df <- read.csv ("http://tinyurl.com/api-202-tf-1")`

In Excel: <http://tinyurl.com/api-202-tf-2>

What's the deal with regression?

API 202: TF Session 1

Nolan M. Kavanagh
January 26, 2024



Goals for today

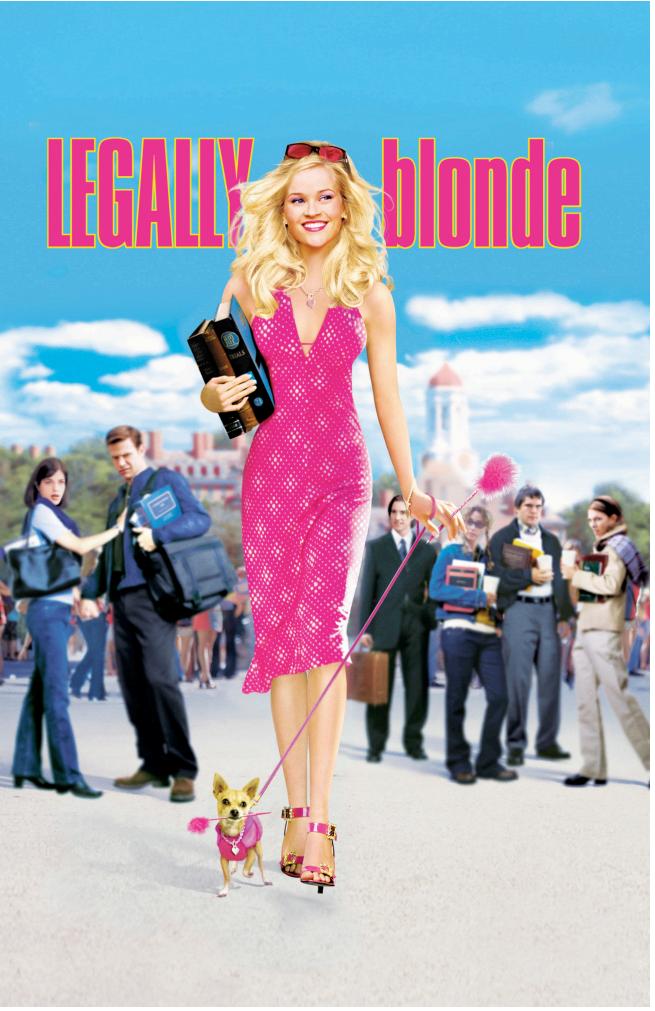
- 1. Get to know one another a little better.**
- 2. Review regression notation, including the PRF vs. SRF.**
- 3. Learn how to graph bivariate relationships.**
- 4. Learn how to run regressions.**
- 5. Review how to interpret regressions.**

We'll treat this session like a workshop with interactive examples.



MD/PhD student in health policy.

**“I don’t need backups.
I’m going to Harvard.”**



Hi, I'm Nolan.



GO BLUE!

My research is on the politics of health.

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Letter Does Health Vulnerability Predict Voting for Right-Wing Populist Parties in Europe?

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ANIL MENON *University of Michigan*
JUSTIN E. HEINZE *University of Michigan*

Why do voters in developed democracies support right-wing populist parties? Existing research focuses on economic and cultural vulnerability, but little attention has been paid to the role of health vulnerability. We argue that health vulnerability may have a similar influence on voters. To test this argument, we analyzed all waves of the European Social Survey (2002–2020). Our findings suggest that voters with worse self-reported health were significantly more likely to vote for right-wing populist parties. The relationship persists even after accounting for measures of cultural and economic vulnerability, as well as voter satisfaction with both their personal lives and their country's health system. The influence of health on support for right-wing populist parties appears to be greater than that of income and self-reported economic insecurity, while less than that of gender and attitudes about immigration. Our findings suggest that policies affecting public health could shape not only health outcomes but also the political landscape.

INTRODUCTION

Right-wing populist parties are surging in popularity across the Western world (Norris and Inglehart 2010). Why do voters in developed democracies support such parties? A great body of research has identified economic insecurity and cultural backlash as potential drivers of recent populist successes (Algan et al. 2007; Hochschild 2016; Inglehart and Norris 2016; Kavanagh and Menon 2018; Rodrik 2018; Smith and Hanley 2018). According to these explanations, once-dominant socioeconomic groups perceive an erosion of their economic opportunities or a threat to their privileged status in society. These threats cause voters' perceived vulnerability in motivating them to support parties that promise to restore their socioeconomic standing through anti-multiculturalism, antiglobalisation, and anti-immigration (Inglehart and Norris 2016).

We argue that voters' perceived health may similarly contribute to populist support via a similar mechanism. The development of illness and disability often produces frustration with one's physical and emotional limitations, and it prompts people to compare themselves with their peers (Banks, Gibson, and Baum 2013; Martz and Liao 2007).

This experience may increase an individual's sense of personal vulnerability regardless of their socioeconomic background. They may then blame their misfortune on the political system, and seek to change or dismantle existing political and economic structures (Lacouture 2005; Nassbaum 2018). If true, individuals who suffer poorer health and more disability would be more likely to support the political status quo. This desire to maintain the status quo may draw them toward parties that campaign for a fundamental restructuring of a "biased and broken" system.

As such, health-related vulnerability may contribute to the rise of right-wing populism. Indeed, some research has associated declining population health with right-wing populist voting. U.S. counties that experienced the greatest rise in mortality over recent decades, especially among whites, were most likely to vote for President Donald Trump in the 2016 election (Kluit et al. 2016; Bilal, Knapp, and Cooper 2018; Bor 2017). Similar associations have been shown for rates of chronic opioid use (Goodwin et al. 2018) and other markers of poor health (Wasylyshyn, et al., 2018; Kavanagh et al. 2017).

In the U.K., areas that experienced greater rises in

"deaths of despair" due to suicide or drug overdose in the previous decade were more likely to vote for Brexit (Koltai et al. 2019). However, the relationship between poor health and right-wing populist voting remains to be tested, and the causal link will require appropriate controls for economic and cultural vulnerability.

Understanding how poor health influences right-wing populist support could have important implications for

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My go-to karaoke song is “Since U Been Gone.”

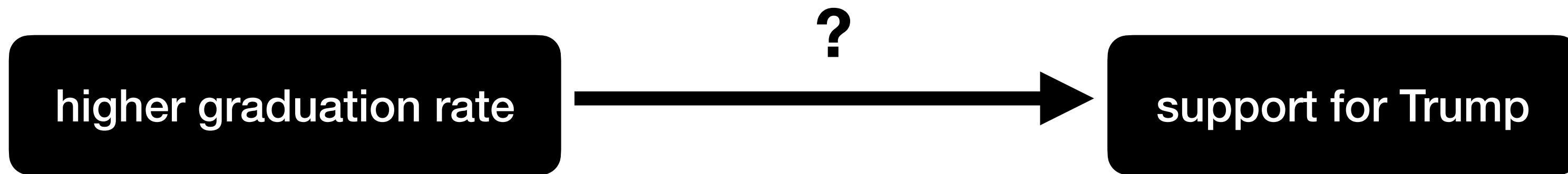


Overview of our sample data

state	State of county	<i>Administrative</i>
county_fips	County FIPS identifier	<i>Administrative</i>
pc_under_18	Percent of county under age 18	<i>American Community Survey (2016–2020)</i>
pc_over_65	Percent of county over age 65	<i>American Community Survey (2016–2020)</i>
pc_male	Percent of county that is male	<i>American Community Survey (2016–2020)</i>
pc_black	Percent of county that is Black	<i>American Community Survey (2016–2020)</i>
pc_latin	Percent of county that is Hispanic/Latino	<i>American Community Survey (2016–2020)</i>
pc_hs_grad	Percent of county that graduated high school	<i>American Community Survey (2016–2020)</i>
unemploy_rate	County unemployment rate (%)	<i>American Community Survey (2016–2020)</i>
median_income	County median income (\$)	<i>American Community Survey (2016–2020)</i>
pc_uninsured	Percent of county without health insurance	<i>American Community Survey (2016–2020)</i>
pc_trump	Percent of county votes for Trump in 2020	<i>MIT Election Lab</i>

Tell me a story.

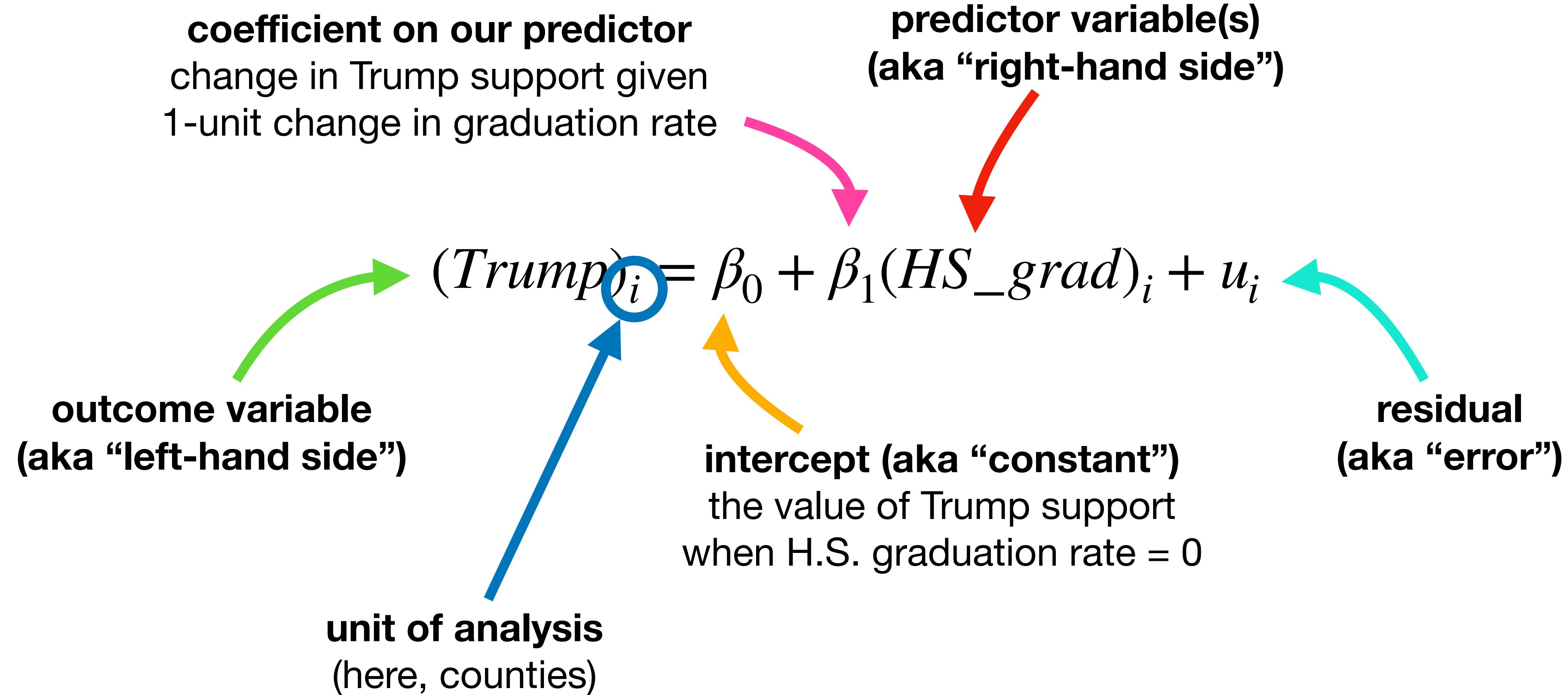
Let's say we're interested in the relationship between high school graduation and support for Trump.



What might be the mechanism?

More education = more income = prefer lower taxes?

Population regression function



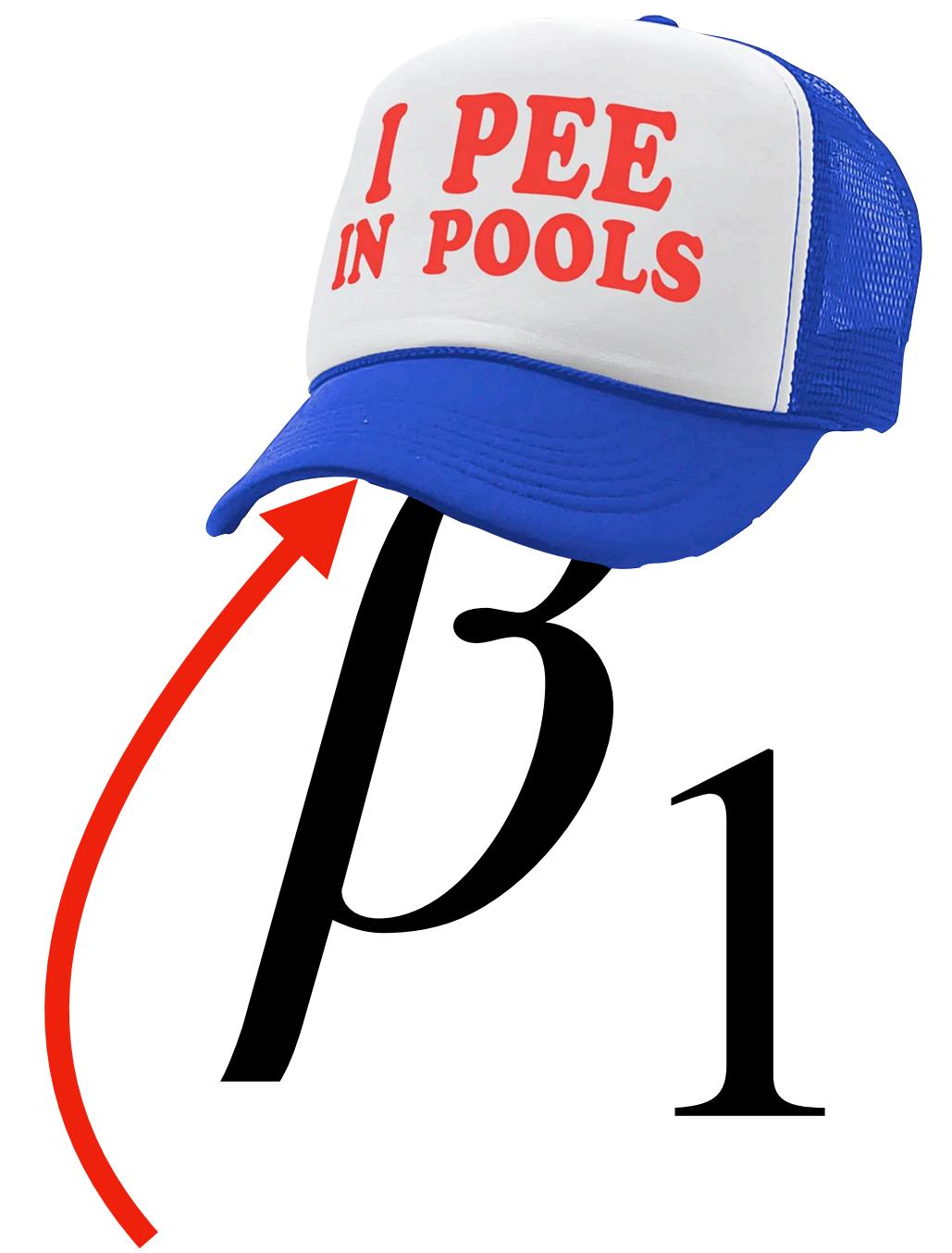
Population regression function

$$(Trump)_i = \beta_0 + \beta_1(HS_grad)_i + u_i$$

Sample regression function

$$(Trump)_i = \hat{\beta}_0 + \hat{\beta}_1(HS_grad)_i + \hat{u}_i$$

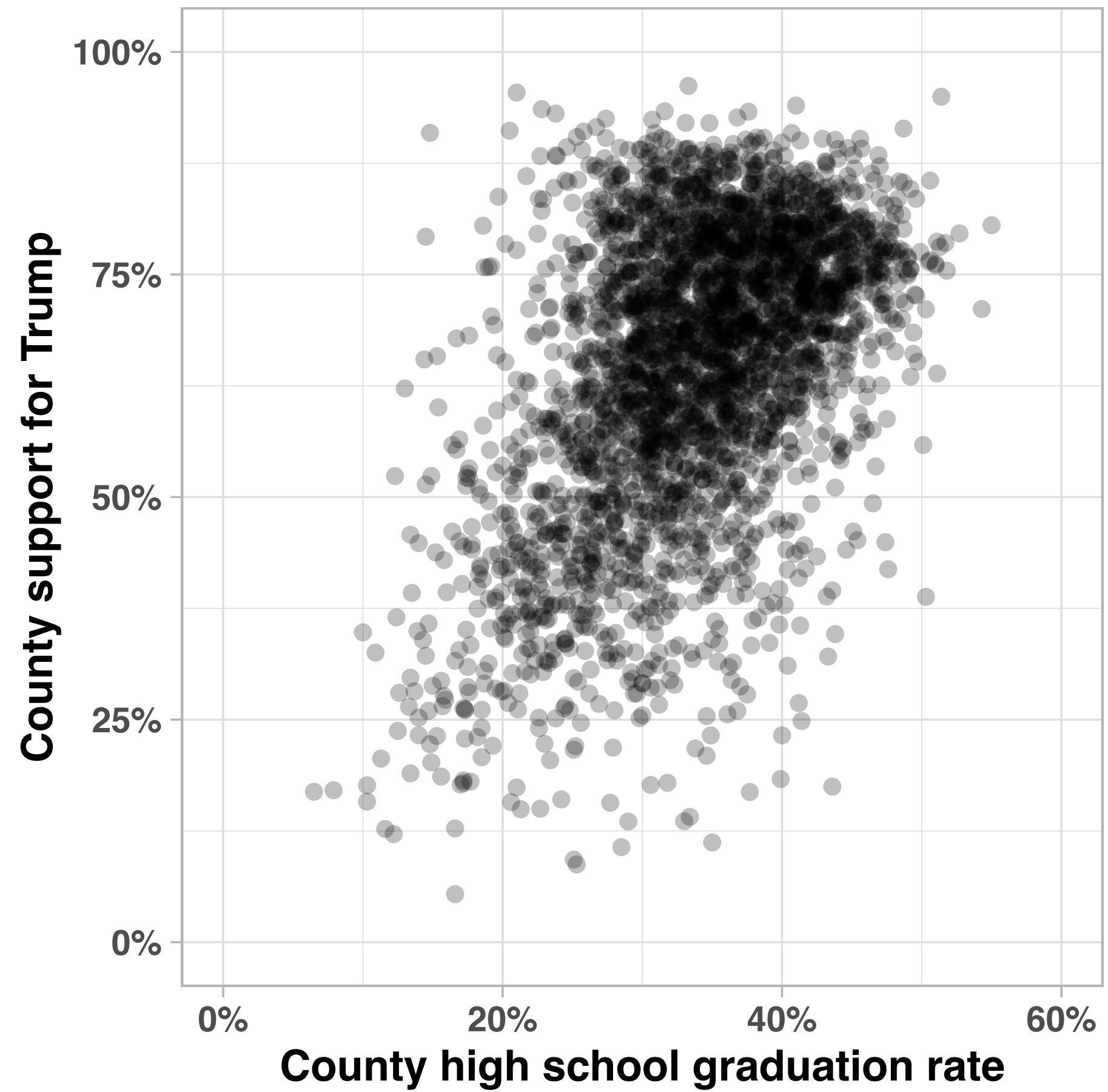
We add “hats” to signify estimated values in our sample.



Only a specific sample would ever wear this hat.

Let's graph our data.

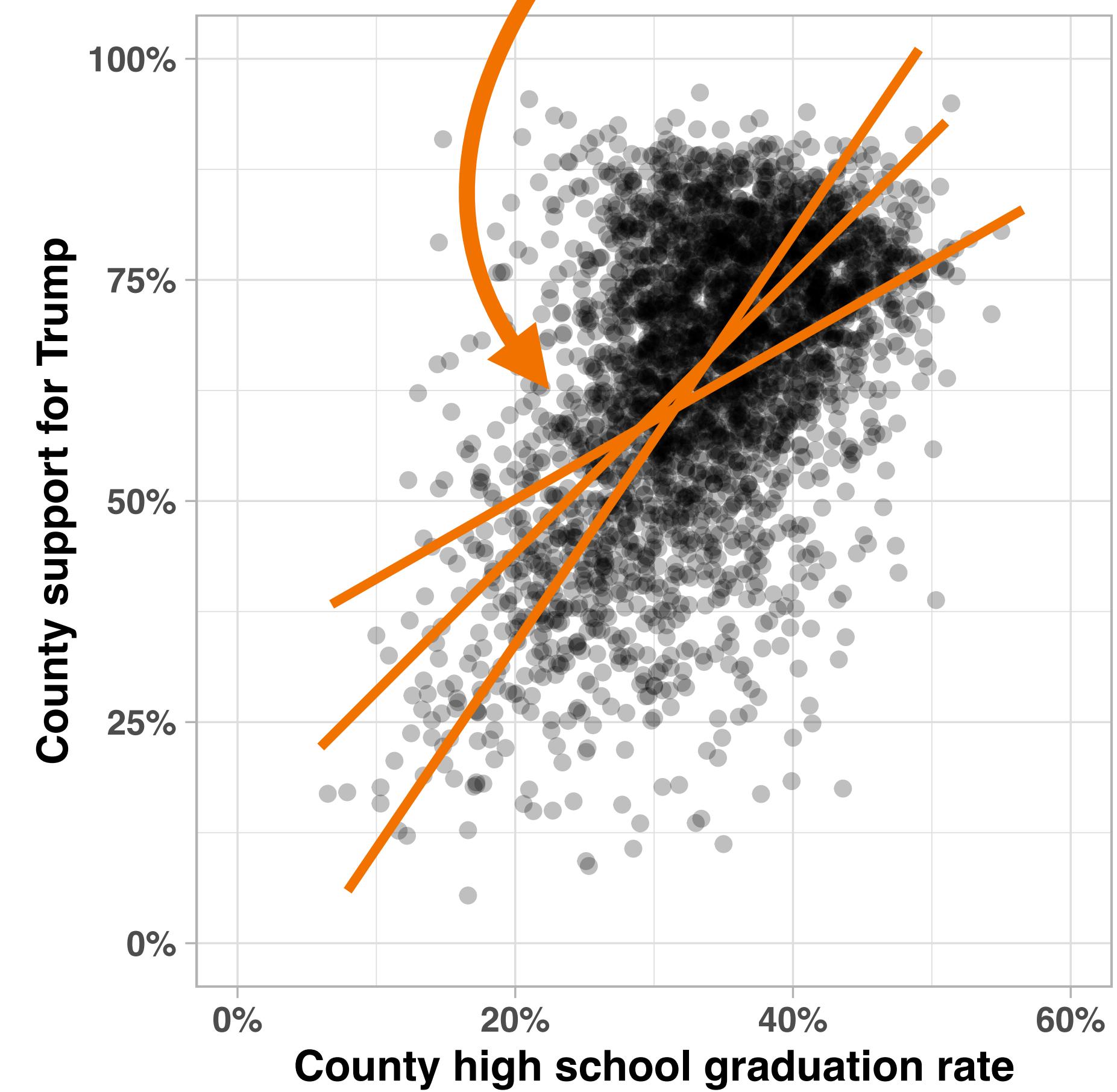
```
# Graph high school graduation and Trump support
plot_1 <- ggplot(df, aes(x=pc_hs_grad, y=pc_trump)) +
  # Add scatterplot points
  geom_point(alpha=0.25) +
  # Labels of axes
  xlab("County high school graduation rate") +
  ylab("County support for Trump") +
  # Cosmetic changes
  theme_light() + theme(text = element_text(face="bold")) +
  scale_y_continuous(limits=c(0,100),
                     labels = function(x) paste0(x,"%")) +
  scale_x_continuous(limits=c(0,60),
                     labels = function(x) paste0(x, "%"))
```



Let's graph our data.

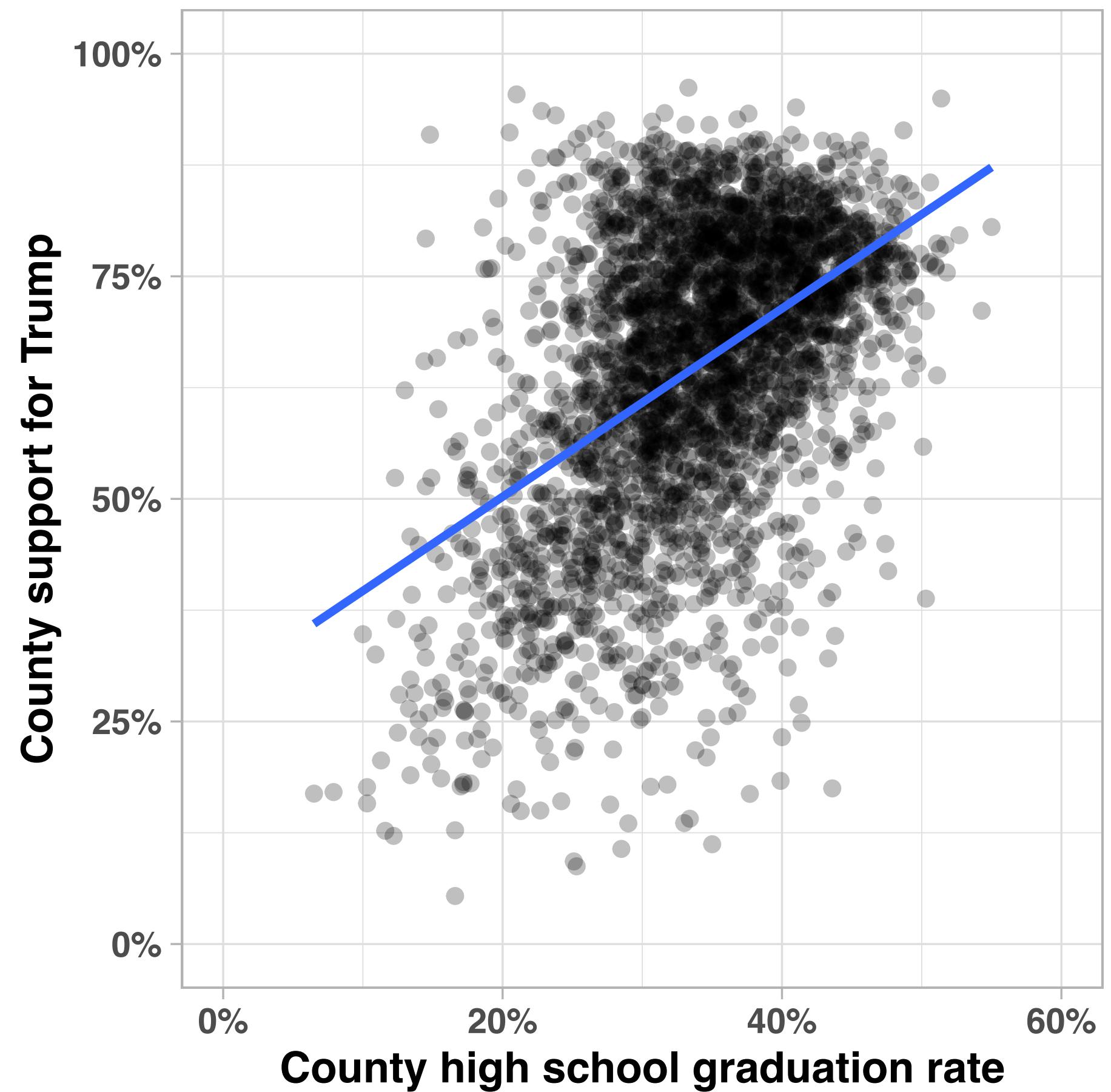
```
# Graph high school graduation and Trump support
plot_1 <- ggplot(df, aes(x=pc_hs_grad, y=pc_trump)) +  
  
  # Add scatterplot points
  geom_point(alpha=0.25) +  
  
  # Labels of axes
  xlab("County high school graduation rate") +
  ylab("County support for Trump") +  
  
  # Cosmetic changes
  theme_light() + theme(text = element_text(face="bold")) +
  scale_y_continuous(limits=c(0,100),
                     labels = function(x) paste0(x,"%")) +
  scale_x_continuous(limits=c(0,60),
                     labels = function(x) paste0(x, "%"))
```

Which line fits best?

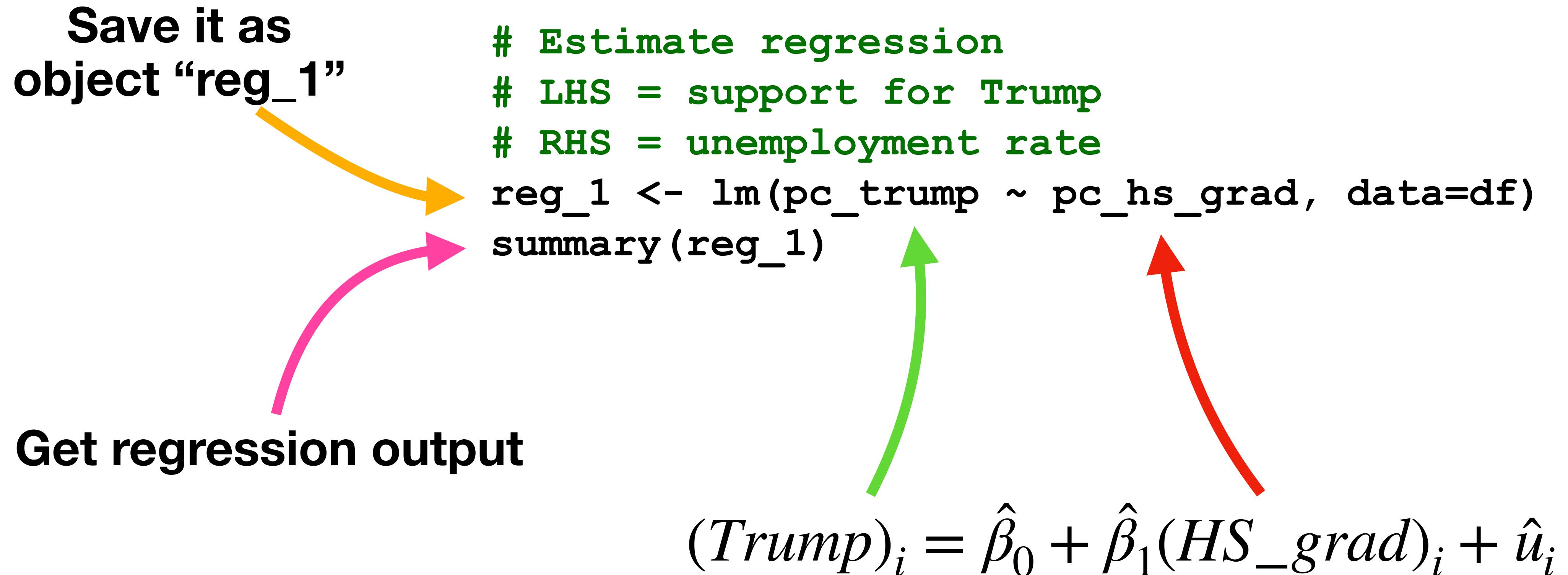


Let's graph our data.

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# Graph high school graduation and Trump support
plot_1 <- ggplot(df, aes(x=pc_hs_grad, y=pc_trump)) +  
  
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  geom_point(alpha=0.25) +  
  
  # Labels of axes
  xlab("County high school graduation rate") +
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  # Cosmetic changes
  theme_light() + theme(text = element_text(face="bold")) +
  scale_y_continuous(limits=c(0,100),
                     labels = function(x) paste0(x,"%")) +
  scale_x_continuous(limits=c(0,60),
                     labels = function(x) paste0(x, "%")) +  
  
  # Add line of best fit
  geom_smooth(method="lm", se=F, formula = y~x)
```



OK fine, let's run a regression.



OK fine, let's interpret a regression.

```
Call:  
lm(formula = pc_trump ~ pc_hs_grad, data = df)  
  
Residuals:  
    Min      1Q  Median      3Q     Max  
-57.708 -8.185  0.838  9.427  46.164  
  
Coefficients:  
            Estimate Std. Error t value Pr(>|t|)  
(Intercept) 29.09825   1.19253   24.40 <2e-16 ***  
pc_hs_grad   1.05721   0.03436   30.77 <2e-16 ***  
---  
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
  
Residual standard error: 14.13 on 3113 degrees of freedom  
Multiple R-squared:  0.2332,          Adjusted R-squared:  0.233  
F-statistic: 947 on 1 and 3113 DF,  p-value: < 2.2e-16
```

OK fine, let's interpret a regression.

```
Call:  
lm(formula = pc_trump ~ pc_hs_grad, data = df)
```

Residuals:

Min	1Q	Median	3Q	Max
-57.708	-8.185	0.838	9.427	46.164

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)		
(Intercept)	29.09825	1.19253	24.40	<2e-16 ***		
pc_hs_grad	1.05721	0.03436	30.77	<2e-16 ***		

Signif. codes:	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' '	1

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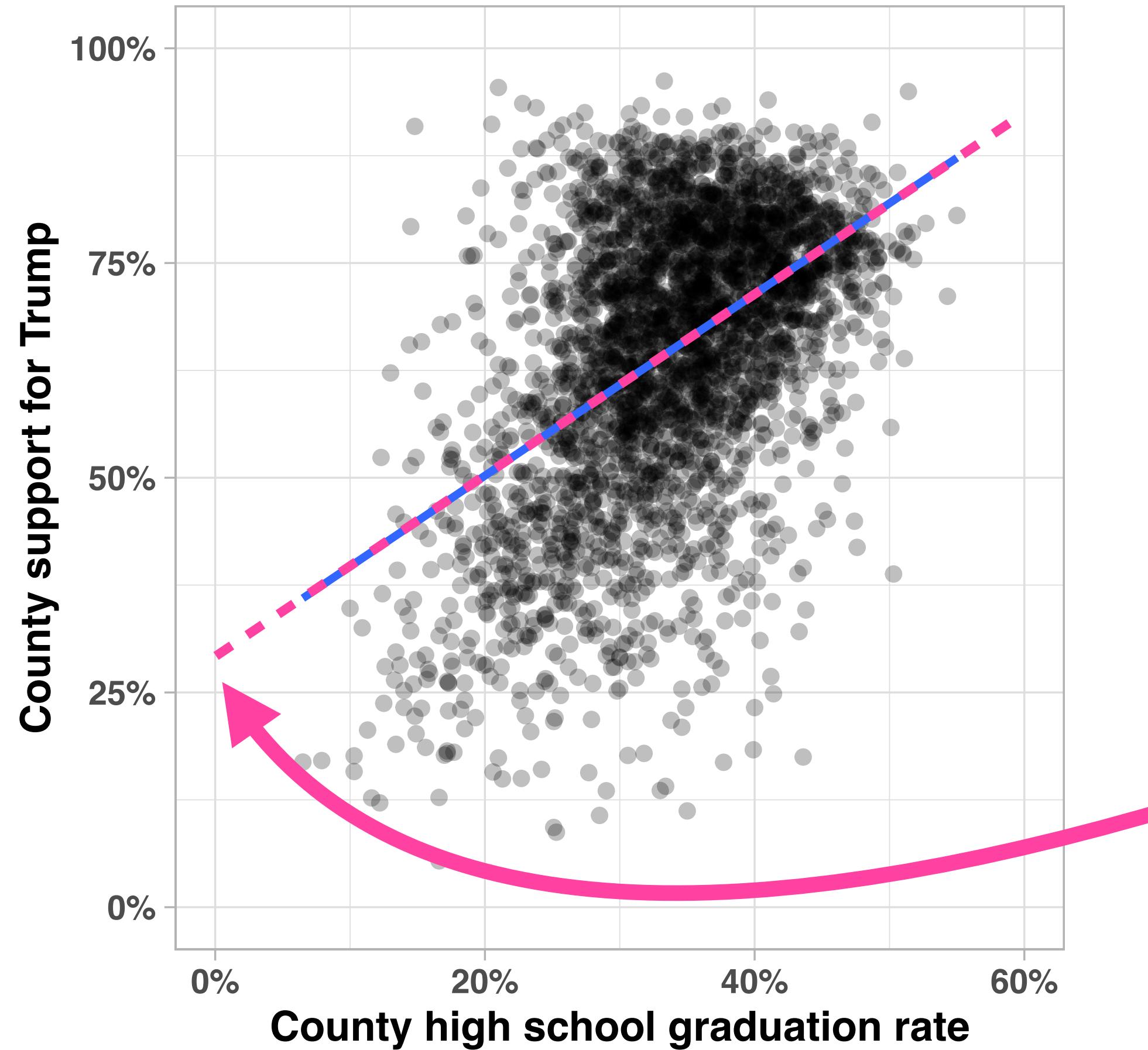
F-statistic: 947 on 1 and 3113 DF, p-value: < 2.2e-16

We'll start with the intercept.

When 0% of a county has graduated high school, support for Trump is an estimated 29.1%.

(Is a graduation rate of 0% meaningful?)

OK fine, let's interpret a regression.



We'll start with the intercept.

When 0% of a county has graduated high school, support for Trump is an estimated 29.1%.

(Is a graduation rate of 0% meaningful?)

**That looks
about right!**

OK fine, let's interpret a regression.

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Call:  
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```

We'll start with the intercept.

When 0% of a county has graduated high school, support for Trump is an estimated 29.1%.

(Is a graduation rate of 0% meaningful?)

The standard error is 1.2%. This gives us a 95% C.I. of $29.1 \pm 1.96 \cdot 1.2 = [26.8\% \text{ to } 31.4\%]$.

The t-statistic is 24.4. The p-value is <0.05.

Thus, we can conclude that the intercept is significantly different from 0.

OK fine, let's interpret a regression.

```
Call:  
lm(formula = pc_trump ~ pc_hs_grad, data = df)
```

Residuals:

Min	1Q	Median	3Q	Max
-57.708	-8.185	0.838	9.427	46.164

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	29.09825	1.19253	24.40	<2e-16 ***
pc hs grad	1.05721	0.03436	30.77	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.13 on 3113 degrees of freedom

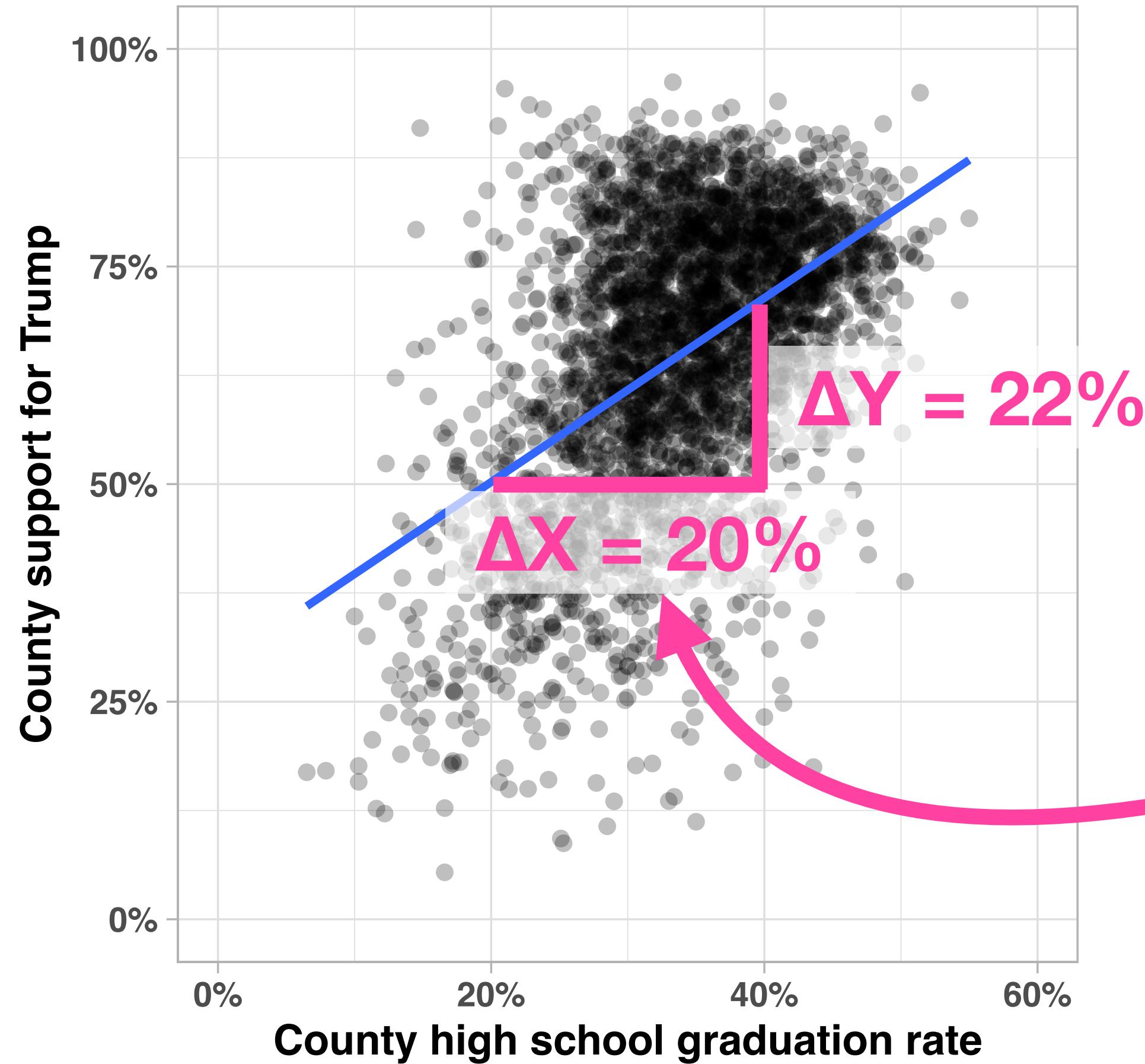
Multiple R-squared: 0.2332, Adjusted R-squared: 0.233

F-statistic: 947 on 1 and 3113 DF, p-value: < 2.2e-16

Now for the coefficient on pc_hs_grad.

For each 1 percentage point (pp) increase in a county's high school graduation rate, the estimated support for Trump increases by 1.1 pp.

OK fine, let's interpret a regression.



Now for the coefficient on `pc_hs_grad`.

For each 1 percentage point (pp) increase in a county's high school graduation rate, the estimated support for Trump increases by 1.1 pp.

OK fine, let's interpret a regression.

Call:

```
lm(formula = pc_trump ~ pc_hs_grad, data = df)
```

Residuals:

Min	1Q	Median	3Q	Max
-57.708	-8.185	0.838	9.427	46.164

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	29.09825	1.19253	24.40	<2e-16 ***
pc hs grad	1.05721	0.03436	30.77	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.13 on 3113 degrees of freedom

Multiple R-squared: 0.2332, Adjusted R-squared: 0.233

F-statistic: 947 on 1 and 3113 DF, p-value: < 2.2e-16

Now for the coefficient on pc_hs_grad.

For each 1 percentage point (pp) increase in a county's high school graduation rate, the estimated support for Trump increases by 1.1 pp.

The standard error is 0.03%. This gives us a 95% C.I. of $1.06 \pm 1.96 \cdot 0.03 = [0.99\% \text{ to } 1.12\%]$.

The t-statistic is 30.8. The p-value is <0.05.

Thus, the coefficient is significantly different from 0. There's a positive association between graduation rates and Trump support.

That's all good. But is it causal?

We'll spend lots of time in API 202 asking this very question.

What problems with a causal interpretation come to mind?

What variables/influences are we missing?