

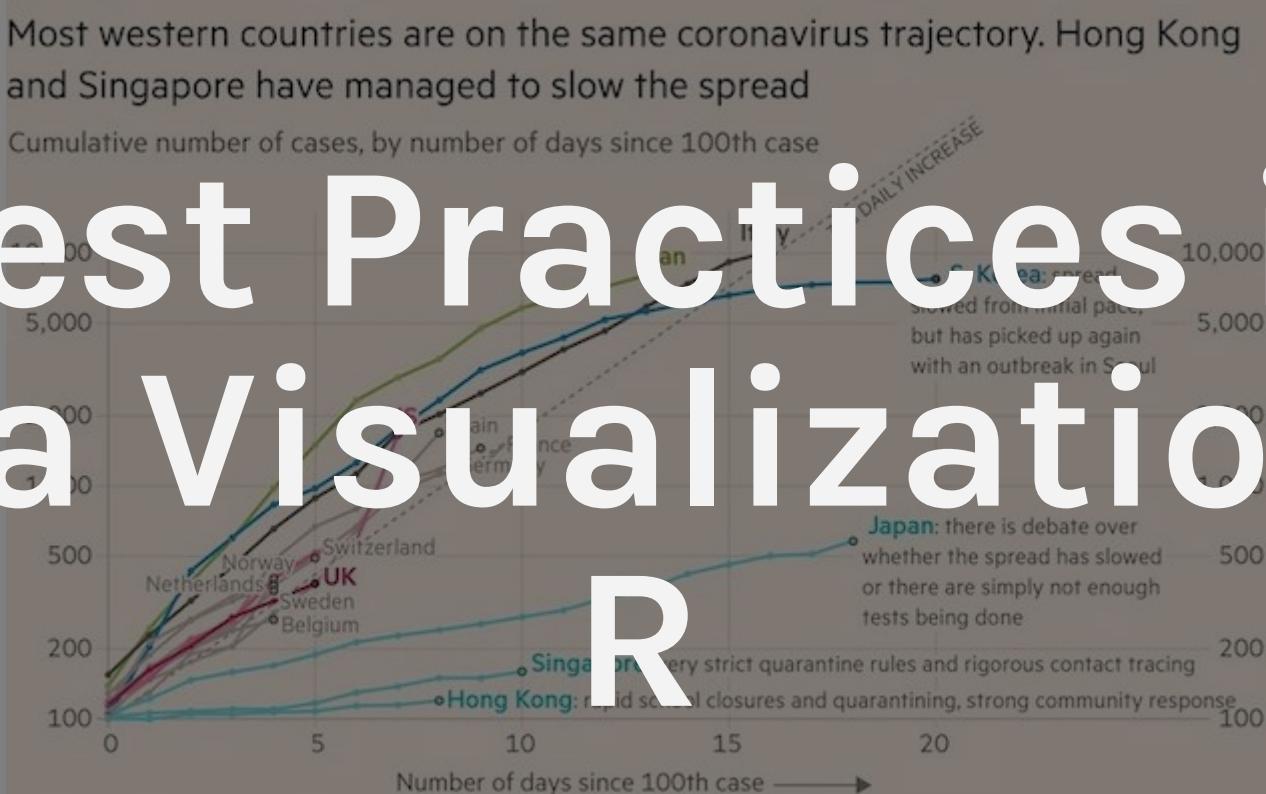


Advanced Data Visualization

Going Deeper with R



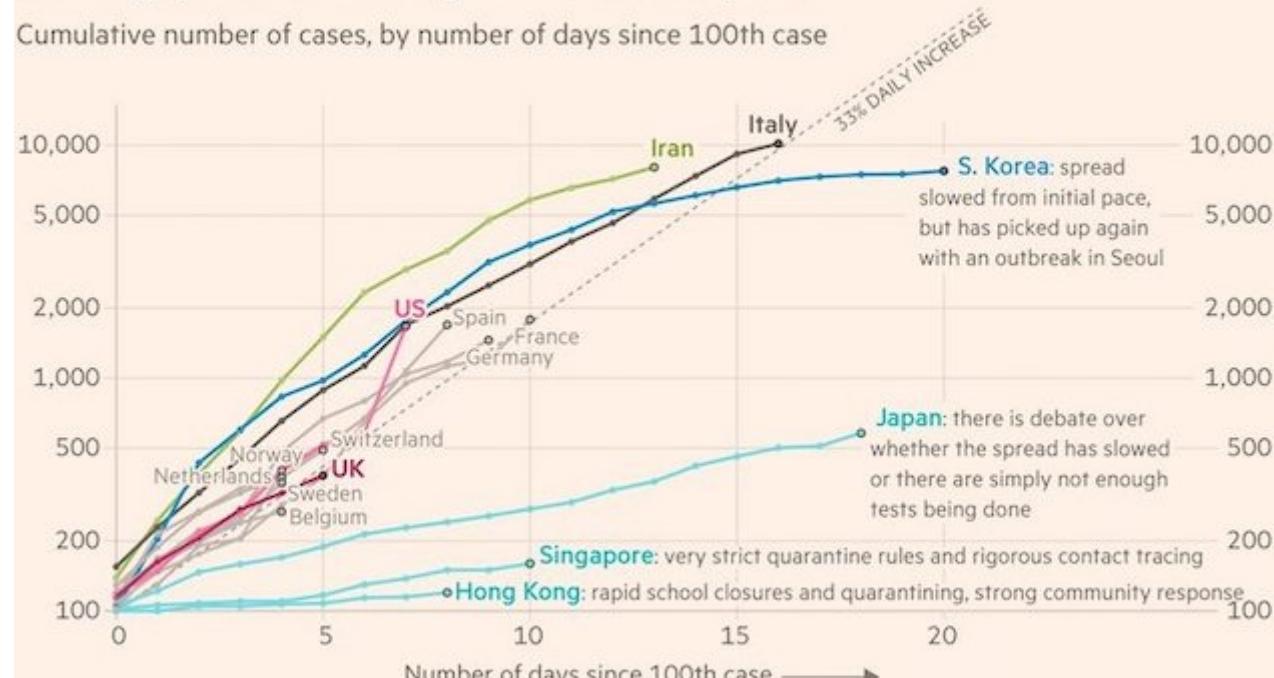
Best Practices in Data Visualization in R





Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE
FT graphic: John Burn-Murdoch / @jburnmurdoch
© FT

Source: [Financial Times, March 11, 2020](#)



it to Shiloh, from thence
nant of the
ch dwelleth
; and the two
nd Phinehas,
ark of the
ark of the
D came into
uted with a
e earth rang
istines heard
t, they said;
oise of this
amp of the
unders

Ps. 89:3 & 99:2
Ex. 29:18, 32;
Num. 7:89

49
1 Cor. 16:13
Aug. 13:1

410 ver. 2
Lev. 20:17;
Deut. 20:25;
Ps. 78:9, 62

Benjamin out of the army, and
came to Shiloh the same day with
his clothes rent, and with earth
upon his head.

13 And when he came, lo, Eli
sat upon a seat by the wayside
watching: for his heart trembled for
the ark of God. And when the man
came into the city, and told it, all
the city cried out.

14 And when Eli heard the
noise of the crying, he said, What
meaneth the noise of this tumult? And the man came in hastily, and
told Eli.

Now Eli was ninety and eight
years old; and his eyes were dim,

20 And about the time of her
death the women that stood by her
said unto her, Fear not; for thou
hast born a son. But she answered
not, neither did she regard it.

21 And she named the child
Ichabod, saying, The glory is
departed from Israel: because the
ark of God was taken, and because
of her father-in-law and her
husband.

22 And she said, The glory is
departed from Israel: for the ark of
God is taken.

The Philistines and the Ark of God

5 And the Philistines took the
ark of God, and brought it into
the house of Dagon, and set it by
Dagon.

6 And when they of Ashdod
saw early on the morrow, behold,
Dagon was fallen upon his face
to the earth before the ark of the
LORD. And they took Dagon, and
set him in his place again.

7 When they arose early
the next morning, behold,
Dagon fallen upon his face
before the ark of the
LORD. And he smote the head of Dagon
with the palms of his hands
upon the threshold;

he destroyed them, and smote them
with hemorrhoids, even Ashdod
and the coasts thereof.

7 And when the men of Ashdod
saw that it was so, they sent
the ark of the God of Israel shall not
abide with us: for his hand is sore
upon us, and upon Dagon our god.

8 They sent therefore and
gathered all the lords of the
Philistines unto them, and said,
What shall we do with the ark
of the God of Israel? And they
answered, Let the ark of the God of
Israel be carried about unto Gath.
And they carried the ark of the God
of Israel about thither.

9 And it was so, that after they
had carried it about, the hand of
the LORD was against the land
with a very great destruction: so
he smote the men of the city, both
small and great, and they had hem-
orrhoids in their secret parts.

10 Therefore they sent the ark of
God to Ekron. And it came to pass
as the ark of God came to Ekron,
that the Ekroneites cried out, saying,
They have brought about the
hand of the God of Israel to us,
and our people.

11 So they sent and gathered
together all the lords of the
Philistines, and said, What shall we
do with the ark of the God of
Israel? Let it go again to the land

4:21
1 Sam. 14:3
Ps. 26:8
S. 78:61

S. 11 Sam. 6:3
8:7:12

5:2
Judg. 16:23

5:3-5:4 19:1
6:46:1, 2
1sa. 46:2

5:4 Jer. 32:2;
Ezek. 6:14, 6:
Mic. 1:7

5:5
See Zeph. 1:12

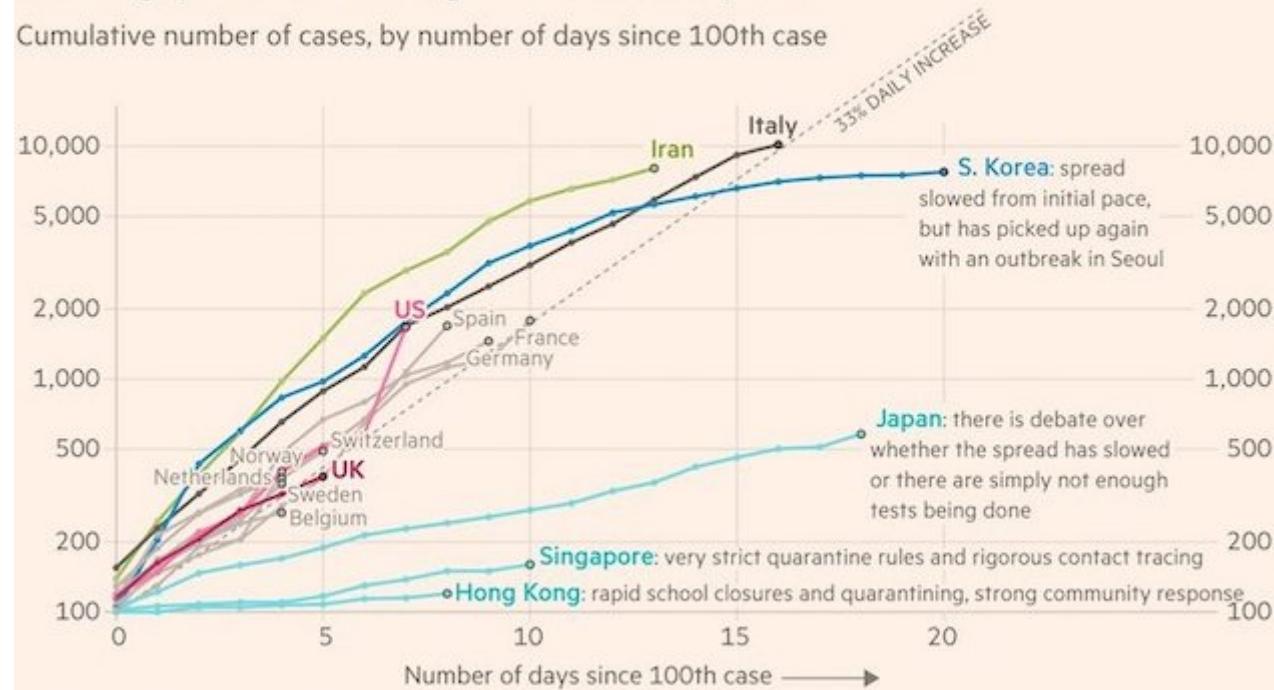
5:6 ver. 7, 11;
Ex. 9:3; Ps. 32:4;
Act. 13:11
1 Sam. 6:5
Deut. 28:27;
Ps. 78:66

Highlight



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



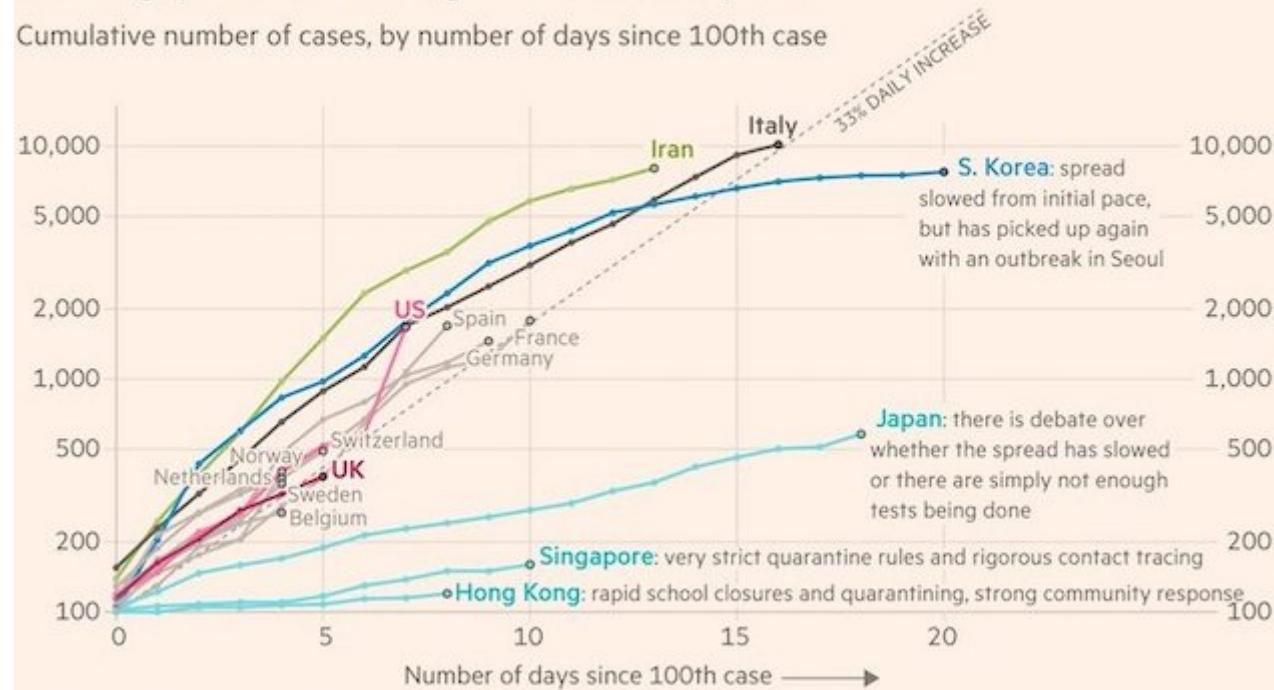
Declutter





Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



Be inspired by
other presenters

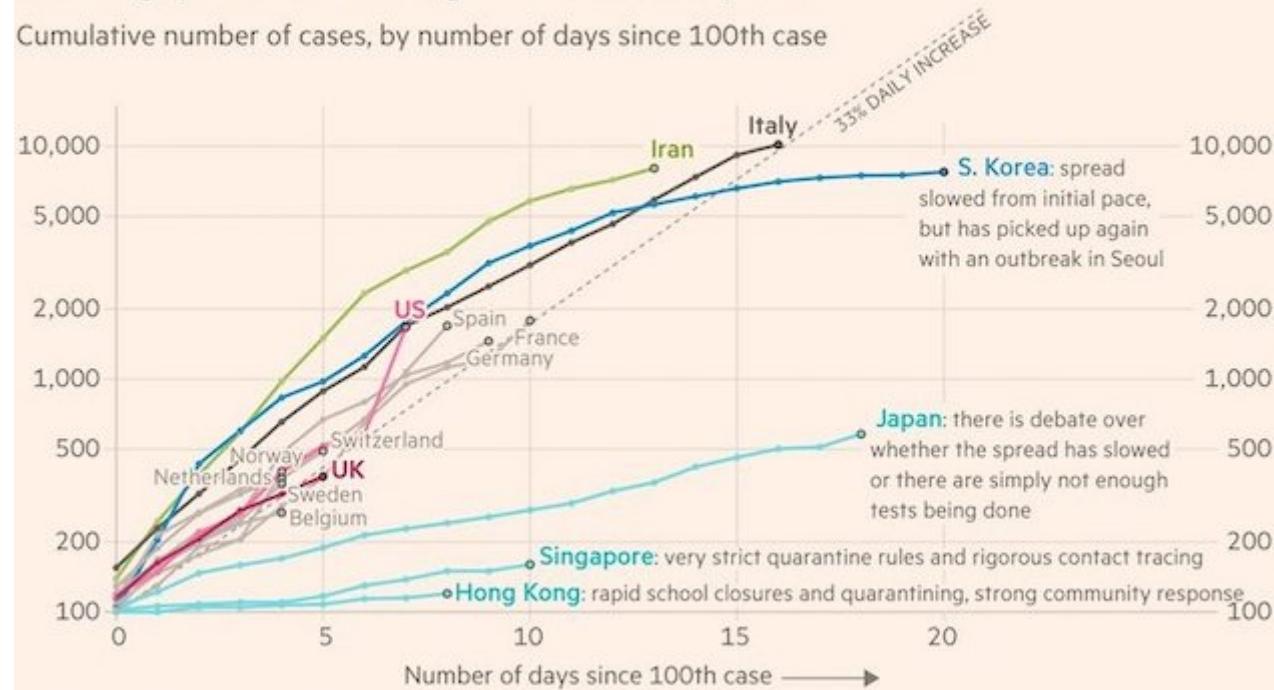
Presentations are tools that
can be used as lectur-
speeches, reports, and

Explain



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT

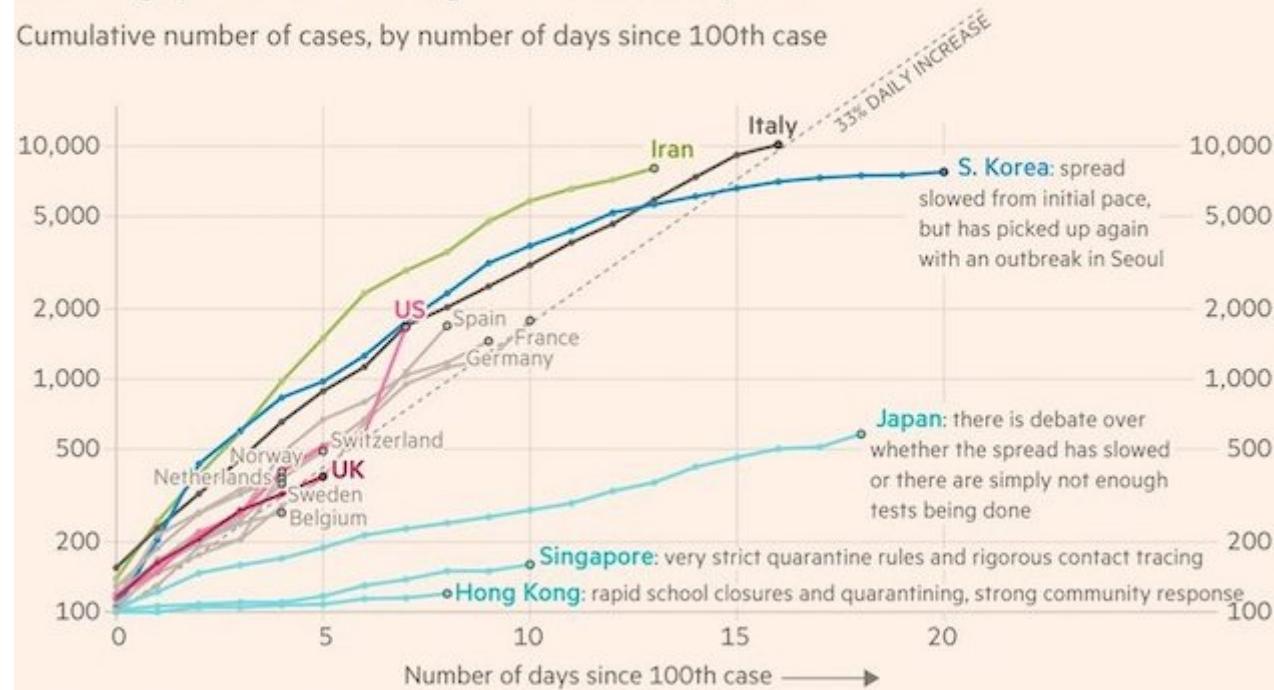


Sparkle



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



Tidy Data



Can We Plot Untidy Data?

```
german_speakers_numeric <- read_excel(path = "data-raw/german-and-french-speakers.xlsx",
                                         sheet = "German speakers",
                                         na = "-") %>%
  clean_names()
```

```
german_speakers_numeric
```

state	number_of_german_speakers_2017
<chr>	<dbl>
Alabama	426
Alaska	331
Arizona	636
Arkansas	NA
California	440

1-5 of 51 rows | 1-2 of 4 columns

Previous [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) ... [11](#) [Next](#)



Can We Plot Untidy Data?

```
ggplot(data = german_speakers_numeric,  
       mapping = aes(x = ???,  
                      y = state))
```



Can We Plot Untidy Data?

```
german_speakers_tidy <- german_speakers_numeric %>%
  pivot_longer(cols = -state,
               names_to = "year",
               values_to = "number") %>%
  mutate(year = parse_number(year))
```

```
german_speakers_tidy
```

state	year	number
<chr>	<dbl>	<dbl>
Alabama	2017	426
Alabama	2018	395
Alabama	2019	711
Alaska	2017	331
Alaska	2018	201

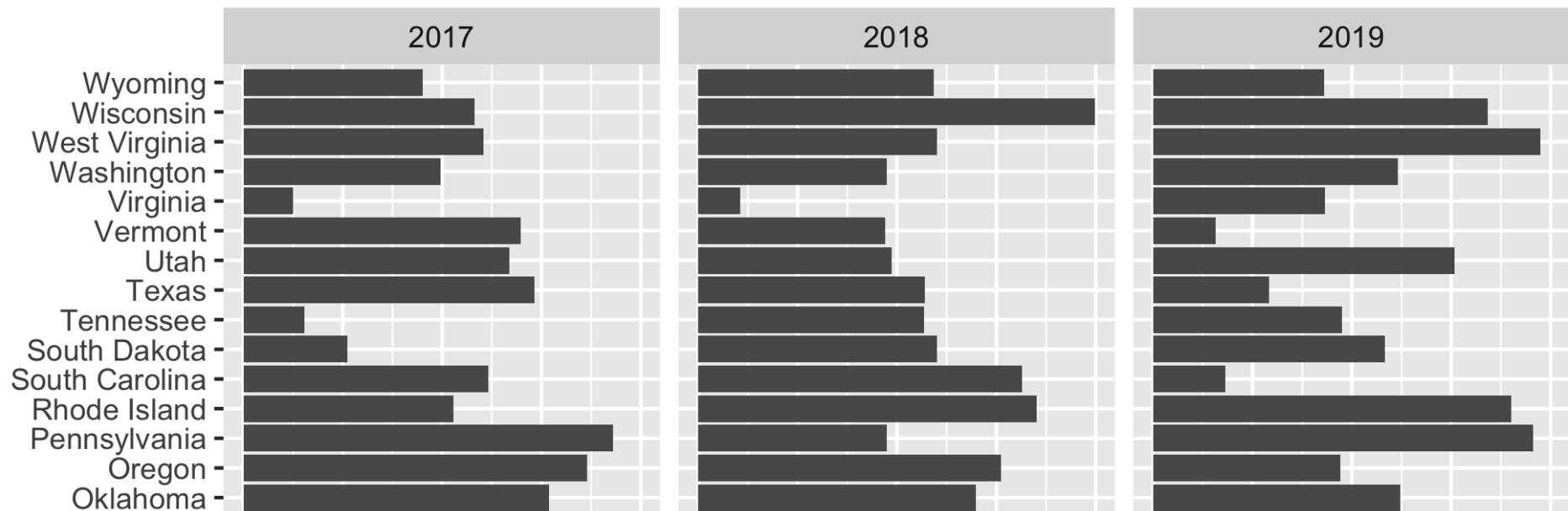
1-5 of 153 rows

Previous 1 2 3 4 5 6 31 Next



Can We Plot Untidy Data?

```
ggplot(data = german_speakers_tidy,  
       mapping = aes(x = number,  
                      y = state)) +  
  geom_col() +  
  facet_wrap(~year)
```





Pipe Data Into ggplot



Load Data

```
third_grade_math_proficiency <- read_rds("data/third_grade_math_proficiency.rds")
```

```
third_grade_math_proficiency
```

school	school_id
<chr>	<dbl>
Brooklyn Primary School	2
Haines Elementary School	4
Pine Eagle Charter School	15
Alsea Charter School	17
Blodgett Elementary School	18

1-5 of 1,389 rows | 1-2 of 6 columns

Previous [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) ... [278](#) [Next](#)



Pipe Data Into ggplot

```
third_grade_math_proficiency %>%  
  filter(year == "2018-2019") %>%  
  filter(district == "Portland SD 1J")
```

school	school_id
<chr>	<dbl>
Abernethy Elementary School	822
Ainsworth Elementary School	823
Alameda Elementary School	824
Arleta Elementary School	826
Astor Elementary School	827

1-5 of 64 rows | 1-2 of 6 columns

Previous [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) ... [13](#) [Next](#)

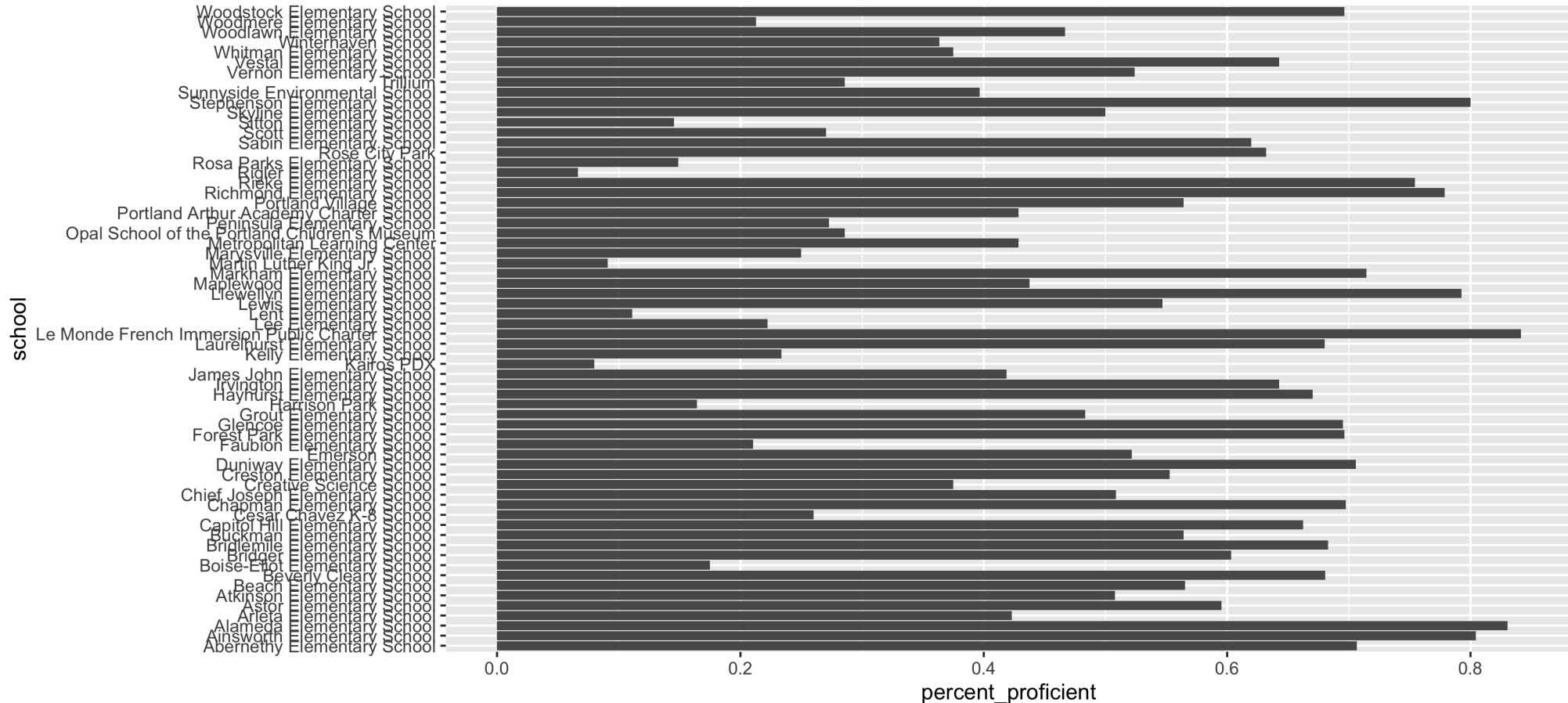


Pipe Data Into ggplot

```
third_grade_math_proficiency %>%
  filter(year == "2018-2019") %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = school, y = percent_proficient)) +
  geom_col() +
  coord_flip()
```



Pipe Data Into ggplot





Your Turn

1. Create a new RMarkdown document
2. Create a data frame called `enrollment_by_race_ethnicity` by reading in your race/ethnicity data from the data wrangling and analysis section using the `read_rds()` function
3. Pipe your data into a bar chart that shows the breakdown of race/ethnicity among students in Beaverton SD 48J in 2018-2019



it to Shiloh, from thence
nant of the
ch dwelleth
; and the two
nd Phinehas,
ark of the
ark of the
D came into
uted with a
e earth rang
istines heard
t, they said;
oise of this
amp of the
unders

4:10 ver. 2
Lev. 20:17.
Deut. 20:25
Ps. 78:62

49
1 Cor. 16:13
Aug. 13:1.

Ps. 89:3 & 99:2
Ex. 29:18, 32:
Num. 7:89

Benjamin out of the army, and
came to Shiloh the same day with
his clothes rent, and with earth
upon his head. Concord. Syl. 100

13 And when he came, lo, Eli
sat upon a seat by the wayside
watching: for his heart trembled for
the ark of God. And when the man
came into the city, and told it, all
the city cried out.

14 And when Eli heard the
noise of the crying, he said, What
meaneth the noise of this tumult? And the man came in hastily, and
told Eli.

Now Eli was ninety and eight
years old; and he had no son
born unto him. And his wife
was barren; and she bare him
not. And Eli's daughter-in-law
was a woman of Shunem; and she
was a widow, and her name
was Naaman: and she dwelt
in the land of Zarephath. And
she went to bring victuals
unto her husband, which
was a Levite, and dwelt
in Shiloh. And when she
came unto Eli, and told
him the words of her
husband, he said unto her,
Go thy way; for thou
shalt have a son, and
he shall be a prophet
unto the people. And
she went away, and
abode in her house.

15 And the woman
conceived, and bare
a son: and when the
time of her delivery
was come, she said,
I will call him Samuel,
because I called
unto the Lord, and
he has given me
this son.

16 And the child
grew, and was weaned:
and Eli took him, and
brought him to the
temple of the Lord
in Shiloh. And Eli
said unto the child,
Samuel, my son,
I have given you
unto the Lord; he
is given to the Lord
for ever.

17 And Samuel
dwelt in the temple
of the Lord, under
the hand of Eli.

18 Now Eli was
old, and he knew
not the Lord, nor
the word of the Lord
to hear.

19 And the child
Samuel grew, and
was strong: and Eli
loved him.

20 And about the time of her
death the women that stood by her
said unto her, Fear not; for thou
hast born a son. But she answered
not, neither did she regard it.

21 And she named the child
Ichabod, saying, The glory is
departed from Israel: because the
ark of God was taken, and because
of her father-in-law and her
husband.

22 And she said, The glory is
departed from Israel: for the ark of
God is taken.

The Philistines and the Ark of God

And the Philistines took the
ark of God, and brought it into
the house of Dagon, and set it by
Dagon.

And when they of Ashdod
saw it early on the morrow, behold,
the sun was fallen upon his face
upon the earth before the ark of the
Lord: and he smote Dagon, and
died in his place again.

When they arose early
the next morning, behold,
the sun was fallen upon his face
upon the earth before the ark of the
Lord: and he smote Dagon
upon the head of Dagon
with the palms of his hands
upon the threshold:

he destroyed them, and smote them
with hemorrhoids, even Ashdod
and the coasts thereof.

7 And when the men of Ashdod
saw that it was so, they sent
the ark of the God of Israel shall not
abide with us: for his hand is sore
upon us, and upon Dagon our god.

8 They sent therefore and
gathered all the lords of the
Philistines unto them, and said,
What shall we do with the ark
of the God of Israel? And they
answered, Let the ark of the God of
Israel be carried about unto Gath.
And they carried the ark of the God
of Israel about thither.

9 And it was so, that after they
had carried it about, the hand of
the LORD was against the
Philistines, and smote them
with a very great destruction:
he smote the men of the city, both
small and great, and they had hem-
orrhoids in their secret parts.

10 Therefore they sent the ark
of God to Ekron. And it came to pass
as the ark of God came to Ekron,
that the Ekroneites cried out, saying,
They have brought about the
hand of the God of Israel to us,
and our people.

11 So they sent and
gathered together all the lords
of the Philistines, and said,
The ark of the God of Israel
let it go again to Zion.

Highlight



Reorder Plots to Highlight Findings

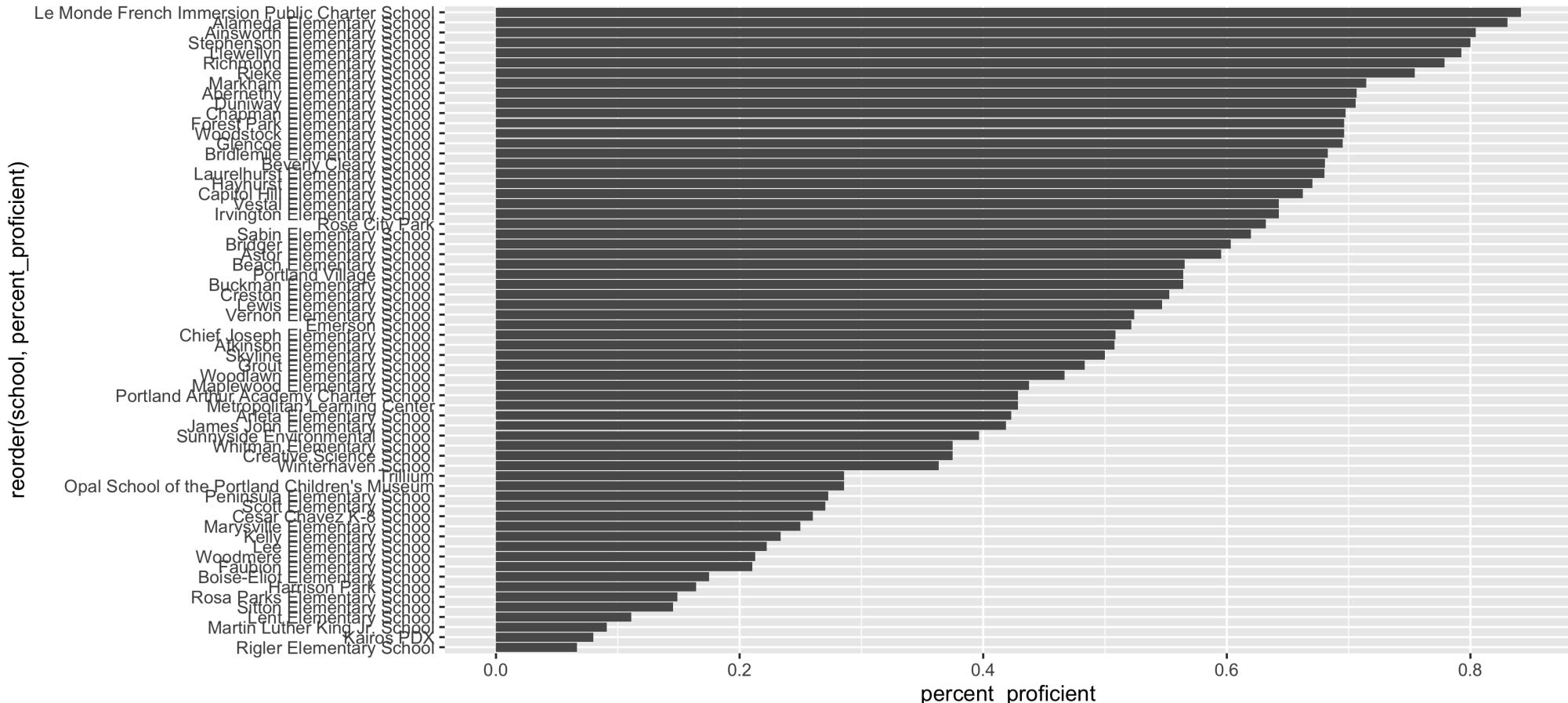


Reorder Plots to Highlight Findings

```
third_grade_math_proficiency %>%
  filter(year == "2018-2019") %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = reorder(school, percent_proficient),
             y = percent_proficient)) +
  geom_col() +
  coord_flip()
```



Reorder Plots to Highlight Findings



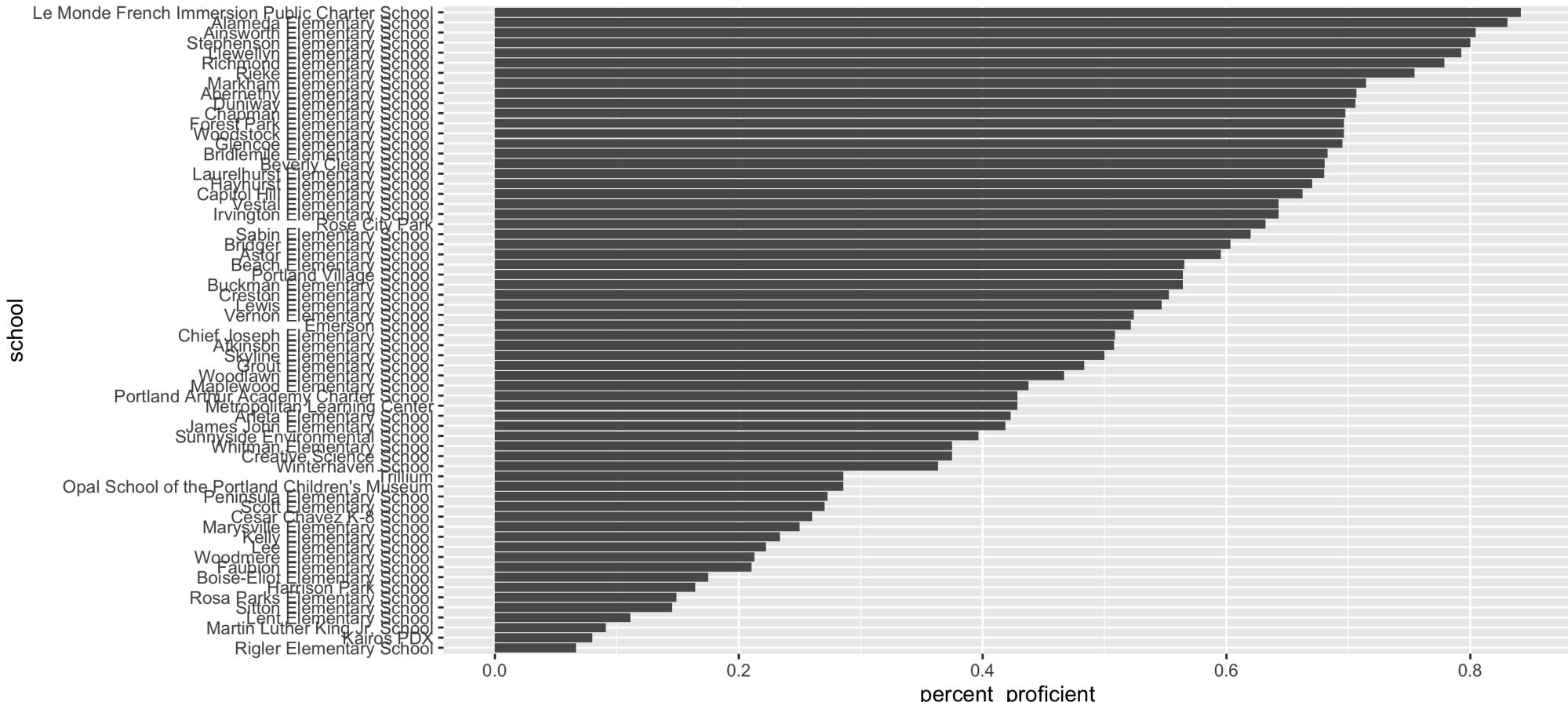


Reorder Plots to Highlight Findings

```
third_grade_math_proficiency %>%
  filter(year == "2018-2019") %>%
  filter(district == "Portland SD 1J") %>%
  mutate(school = fct_reorder(school, percent_proficient)) %>%
  ggplot(aes(x = school,
             y = percent_proficient)) +
  geom_col() +
  coord_flip()
```



Reorder Plots to Highlight Findings





Your Turn

Make a bar chart that shows race/ethnicity in Beaverton SD 48J. As before, filter your data to only include 2018-2019 data and only include Beaverton SD 48J. Then, do the following:

1. Using the `reorder()` function, make a bar chart that shows the percent of race/ethnicity groups in descending order
2. Make the same bar chart using `mutate()` and `fct_reorder()` to reorder the race/ethnicity groups



Line Charts

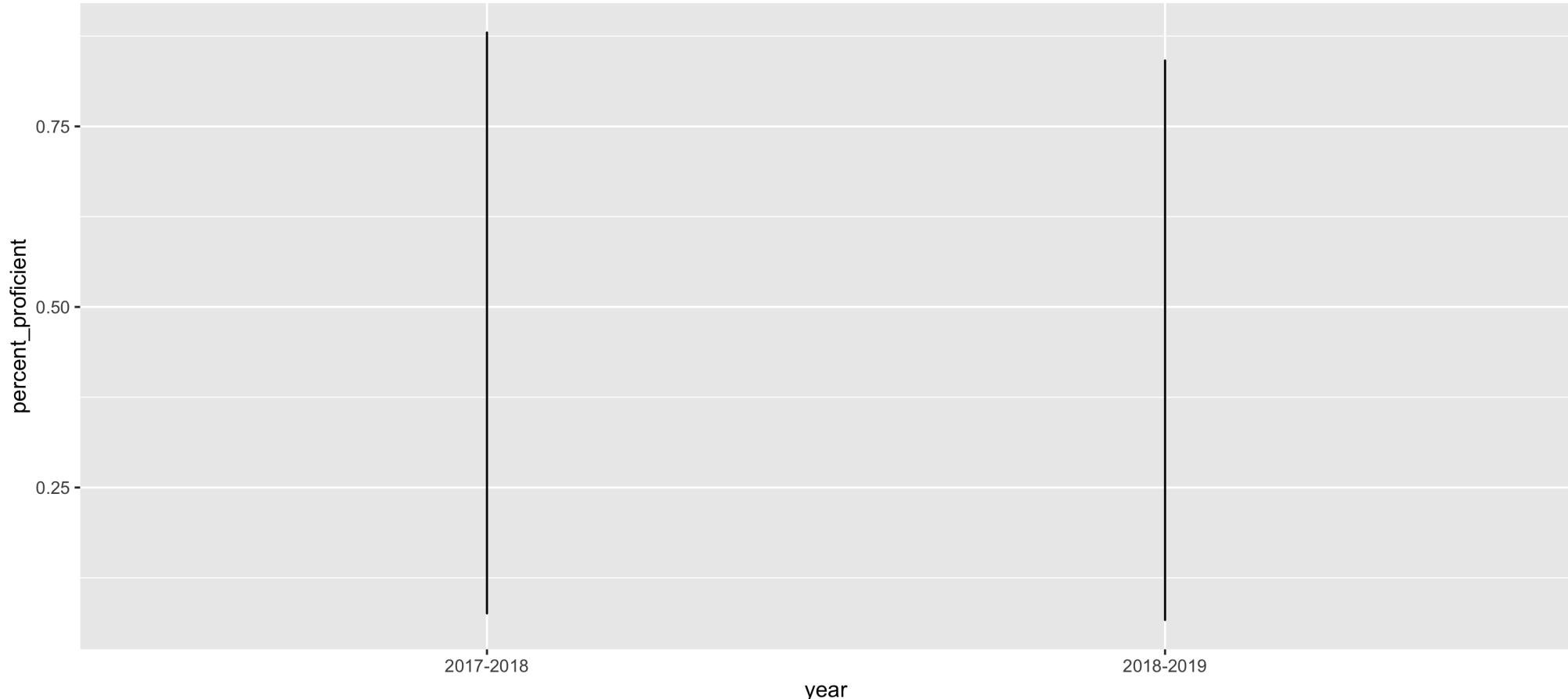


Line Charts

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year,
             y = percent_proficient)) +
  geom_line()
```



Line Charts



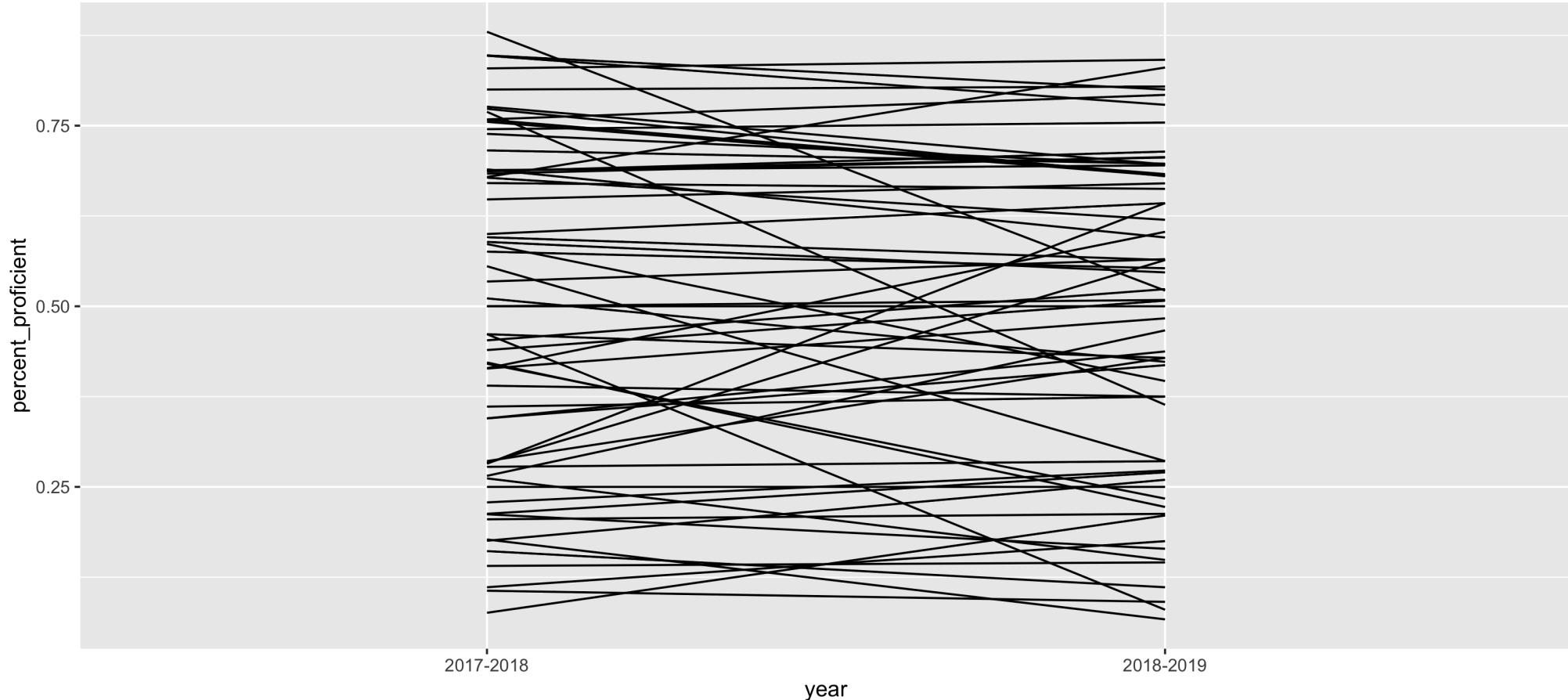


Line Charts

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year,
             y = percent_proficient,
             group = school)) +
  geom_line()
```



Line Charts





Your Turn

Make a line chart that shows the growth in the Hispanic/Latino population in school districts from 2017-2018 to 2018-2019

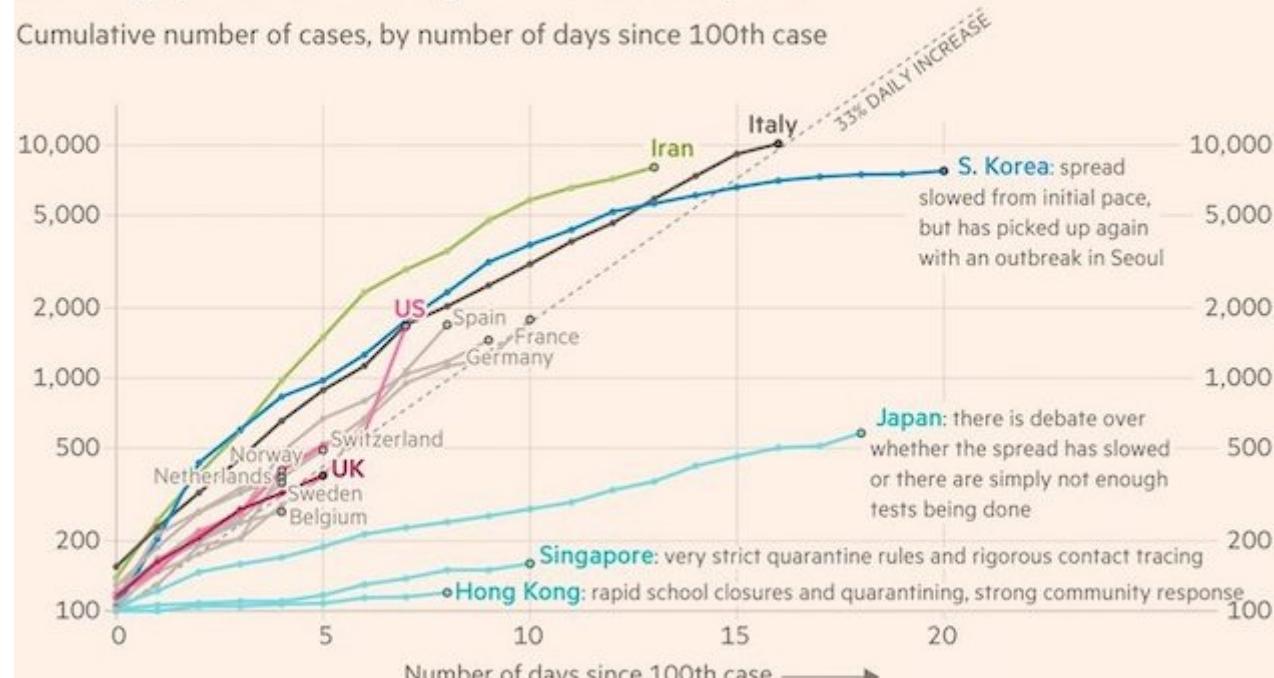


Use Color to Highlight Findings



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

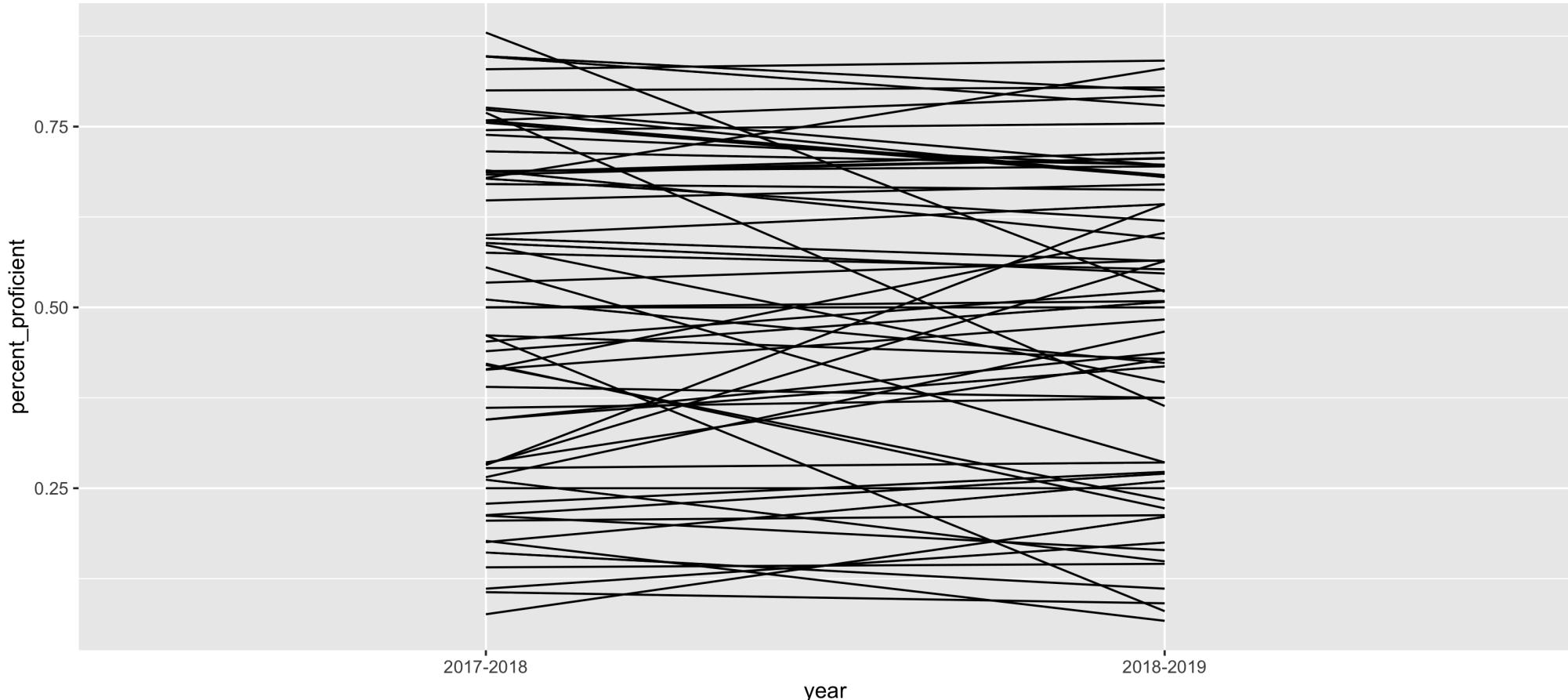
FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT

Source: [Financial Times, March 11, 2020](#)



Use Color to Highlight Findings





Use Color to Highlight Findings

```
highlight_school <- third_grade_math_proficiency %>%
  filter(school == "Vestal Elementary School")
```

```
highlight_school
```

school	school_id	district	district_id
<chr>	<dbl>	<chr>	<dbl>
Vestal Elementary School	896	Portland SD 1J	2180
Vestal Elementary School	896	Portland SD 1J	2180

2 rows | 1-4 of 6 columns



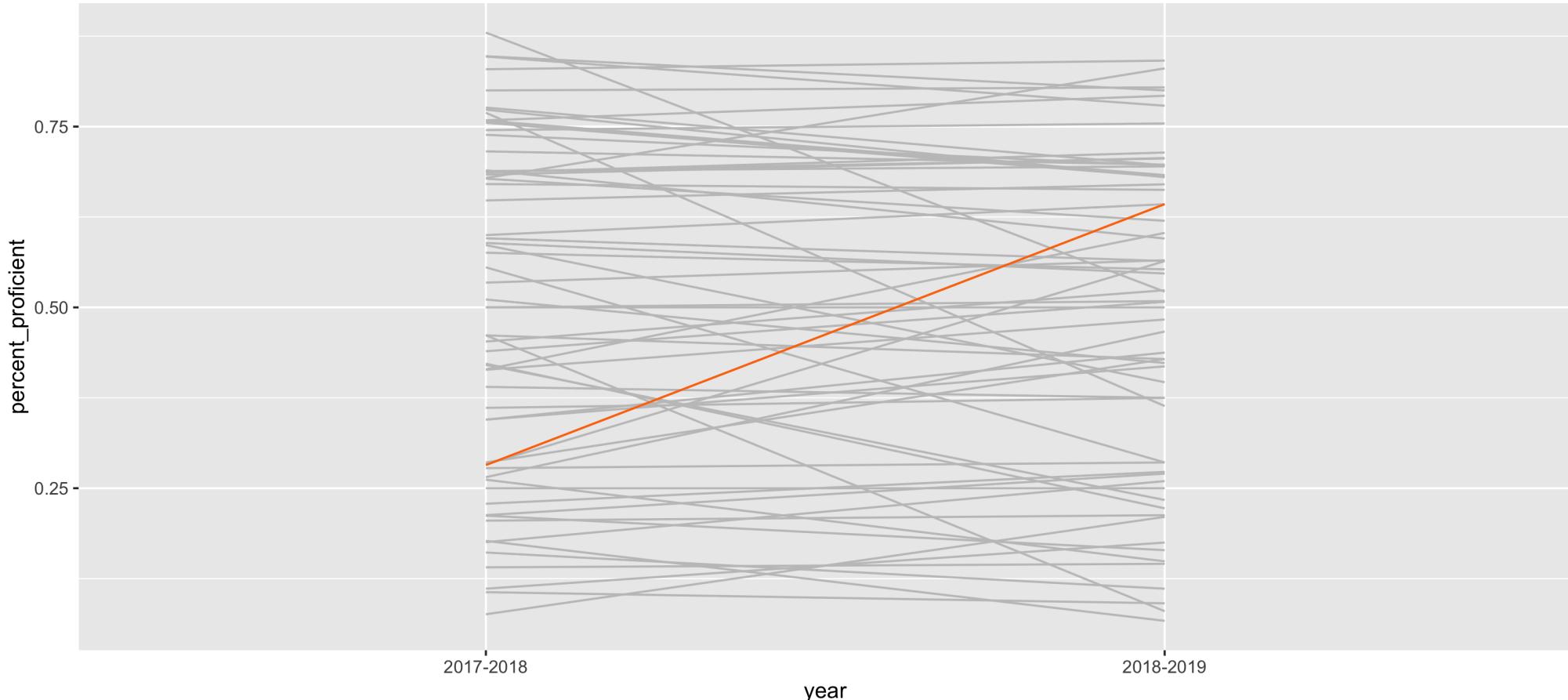
Use Color to Highlight Findings

```
rru_orange <- "#FF7400"
rru_gray <- "#C3C3C3"

third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange)
```



Use Color to Highlight Findings





Your Turn

1. Identify one school district that has had a lot of growth in its Hispanic/Latino population from 2017-2018 to 2018-2019
2. Create a new data frame called `highlight_district` and only include this district in it
3. Use the `highlight_district` data frame to create a new `geom_line()` layer on top of the other data
4. Make sure this new layer is a bright color and all other layers are some type of light gray

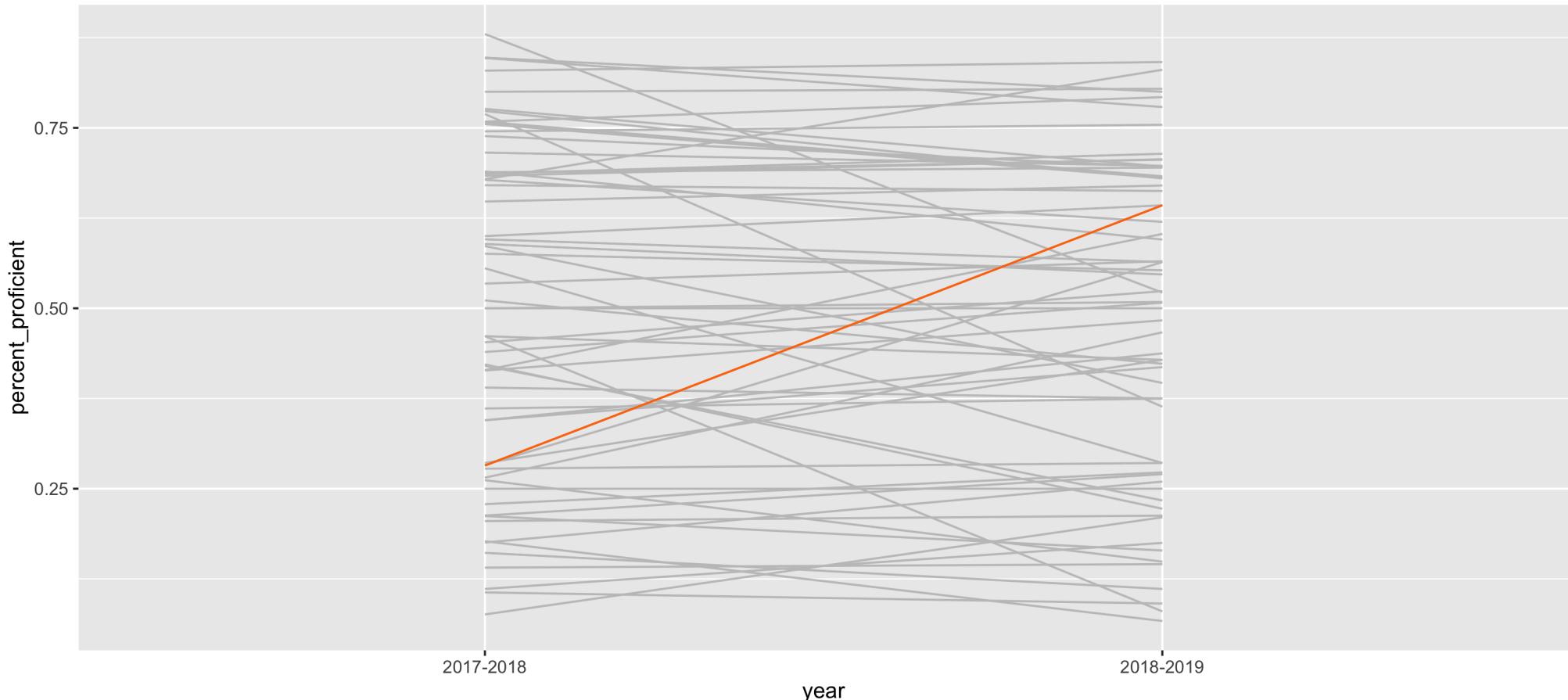


Declutter





Remove the Default Gray Background



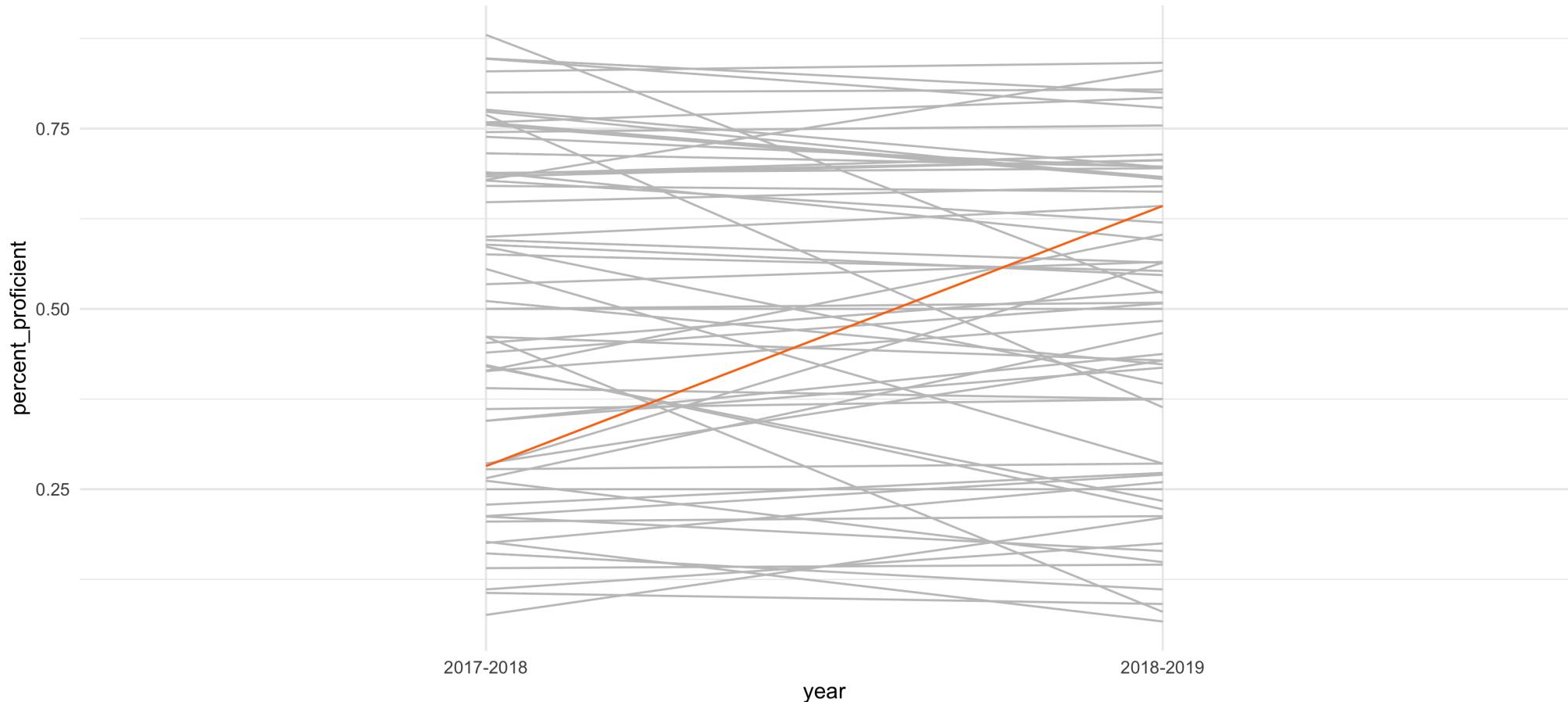


Remove the Default Gray Background

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  theme_minimal()
```



Remove the Default Gray Background





Remove Axis Titles

Modify components of a theme

Source: [R/theme.r](#)

Themes are a powerful way to customize the non-data components of your plots: i.e. titles, labels, fonts, background, gridlines, and legends. Themes can be used to give plots a consistent customized look. Modify a single plot's theme using `theme()`; see `theme_update()` if you want modify the active theme, to affect all subsequent plots. Use the themes available in [complete themes](#) if you would like to use a complete theme such as `theme_bw()`, `theme_minimal()`, and more. Theme elements are documented together according to inheritance, read more about theme inheritance below.

Source: [ggplot2 documentation](#)

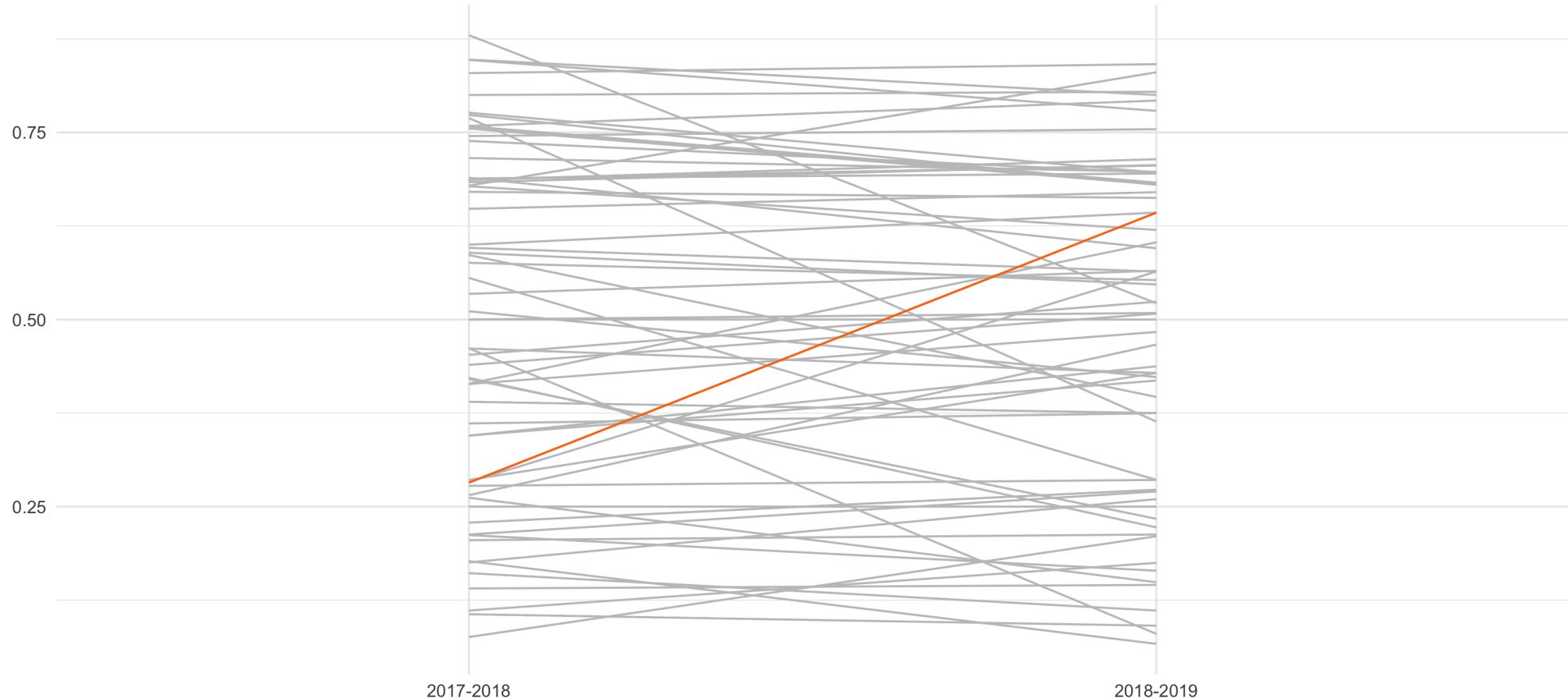


Remove Axis Titles

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  theme_minimal() +
  theme(axis.title = element_blank())
```



Remove Axis Titles



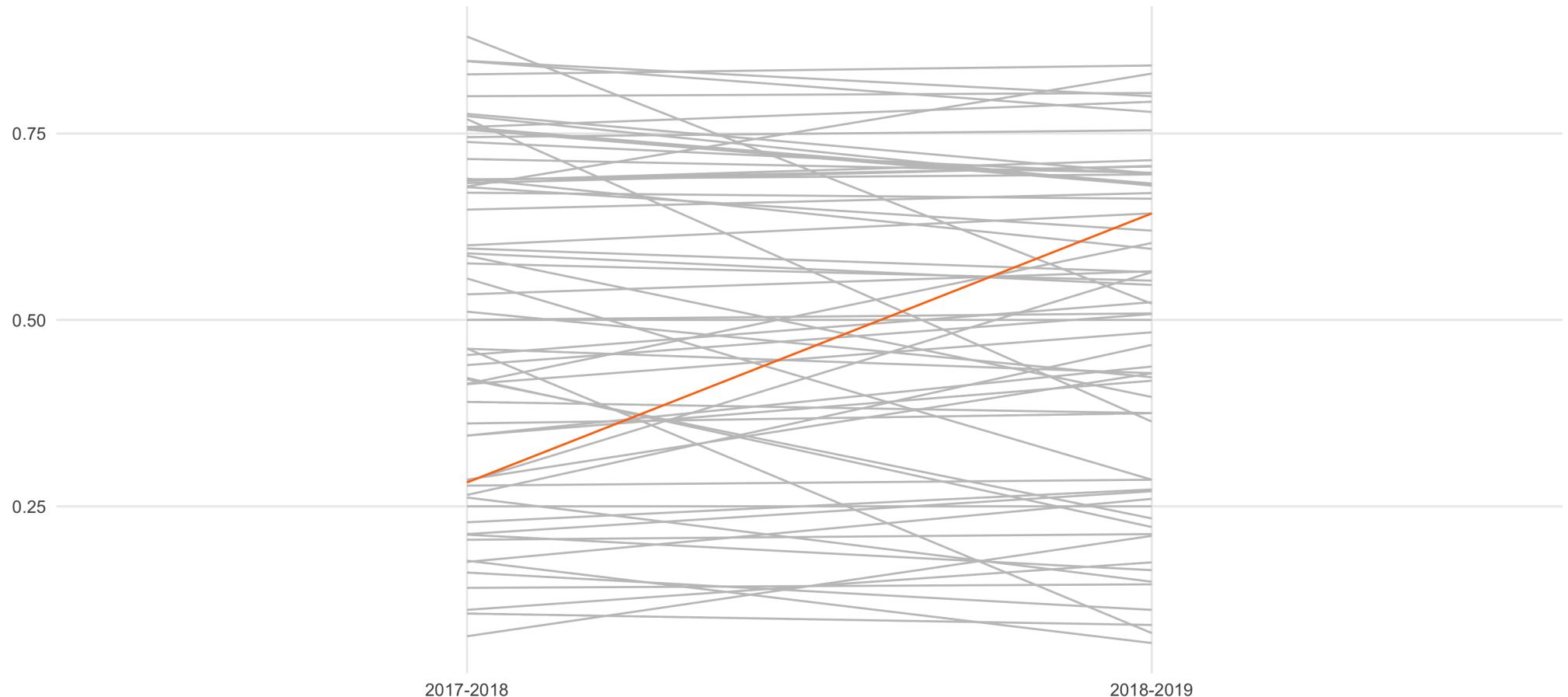


Remove or Minimize Grid Lines

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  theme_minimal() +
  theme(axis.title = element_blank(),
        panel.grid.minor = element_blank())
```



Remove or Minimize Grid Lines





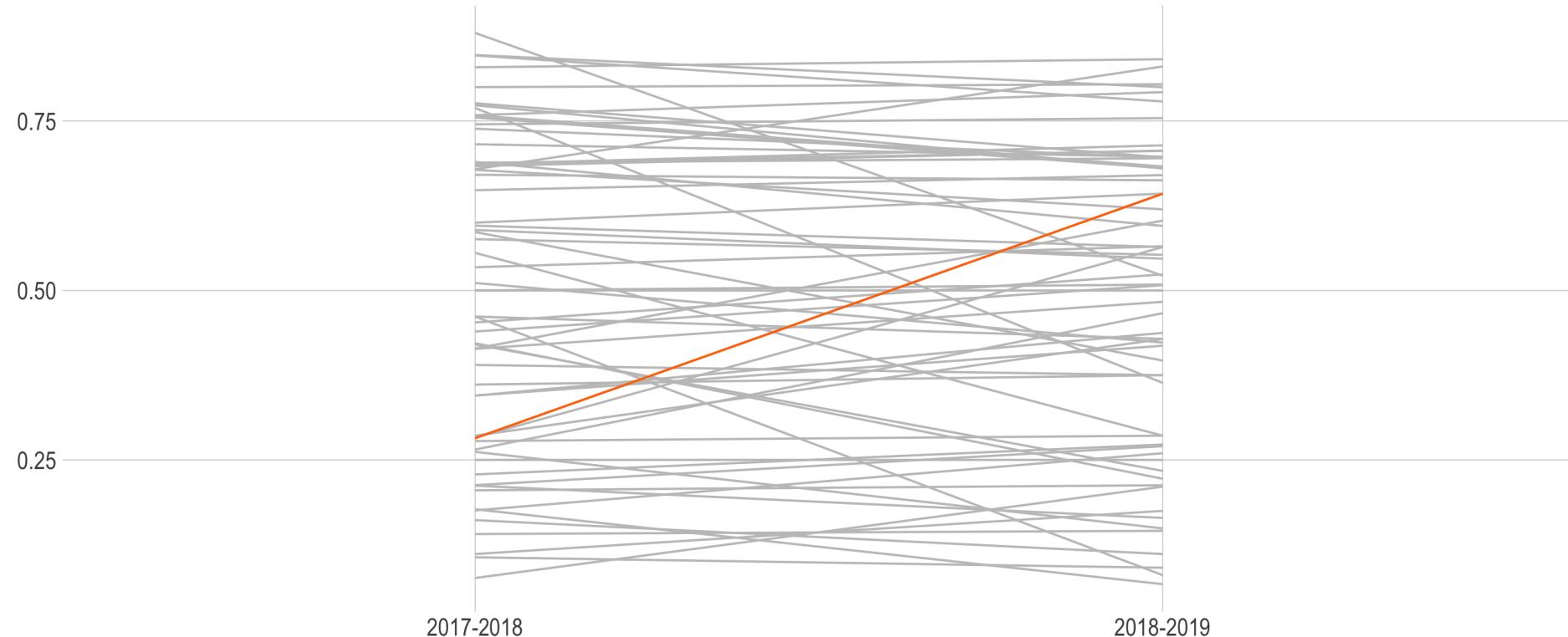
Work with Existing Themes

```
library(hrbrthemes)

third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  theme_ipsum(axis_title_size = 0,
              grid = "XY")
```



Work with Existing Themes





Your Turn

Use some combination of:

- Complete themes: e.g. `theme_minimal()` or `theme_ipsum()` from `hrbrthemes`
- The `theme()` function

Do the following:

1. Remove gray background
2. Remove axis titles
3. Remove or minimize grid lines



Be inspired by
other presenters

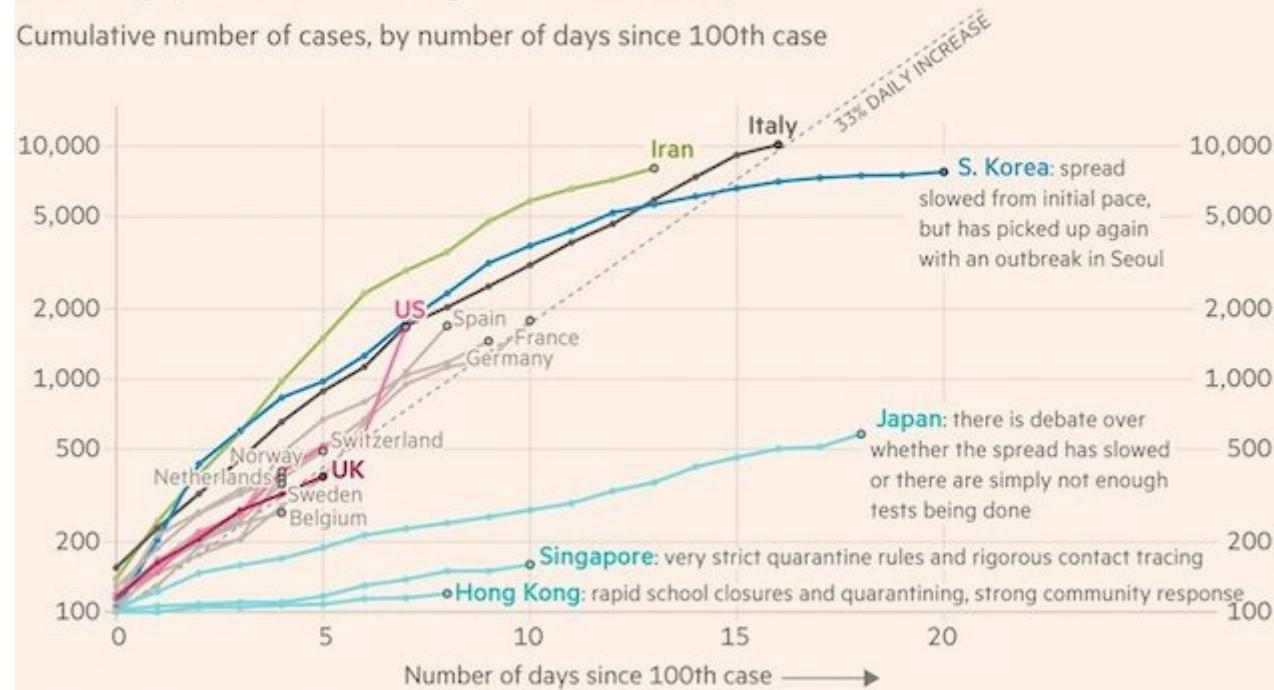
Presentations are tools that
can be used as lectur
speeches, reports, and

Explain



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



Use the `scales` Package for
Nicely Formatted Values



scales

highlight_school

school	school_id	district	district_id
<chr>	<dbl>	<chr>	<dbl>
Vestal Elementary School	896	Portland SD 1J	2180
Vestal Elementary School	896	Portland SD 1J	2180

2 rows | 1-4 of 6 columns



scales

```
library(scales)

highlight_school <- third_grade_math_proficiency %>%
  filter(school == "Vestal Elementary School") %>%
  mutate(percent_proficient_display = percent(percent_proficient, accuracy = 1))
```

```
highlight_school %>%
  select(school, percent_proficient, percent_proficient_display)
```

school	percent_proficient
<chr>	<dbl>
Vestal Elementary School	0.2820513
Vestal Elementary School	0.6428571

2 rows | 1-2 of 3 columns



Your Turn

1. Make a new variable called `percent_display` that shows the `percent_of_total_enrollment` variable as a nicely formatted percent (rounded to the nearest whole number)
2. Make sure you save this as `highlight_district` (i.e. don't just display the result)

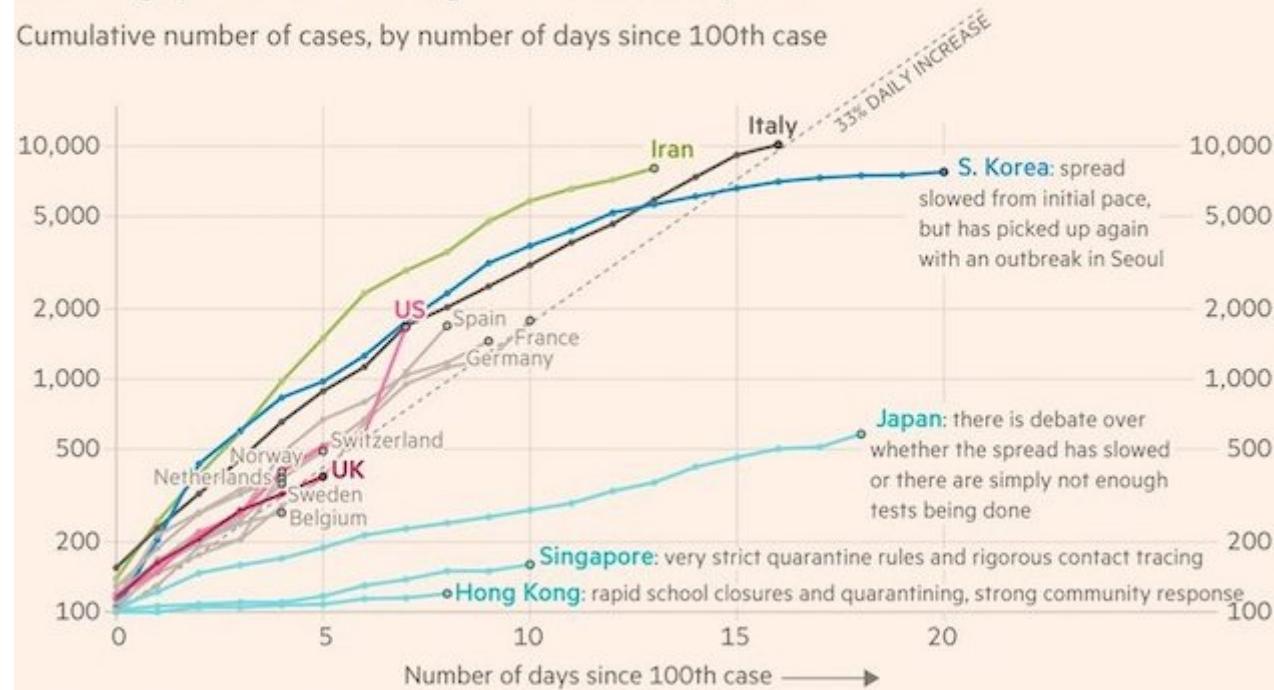


Use Direct Labeling



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



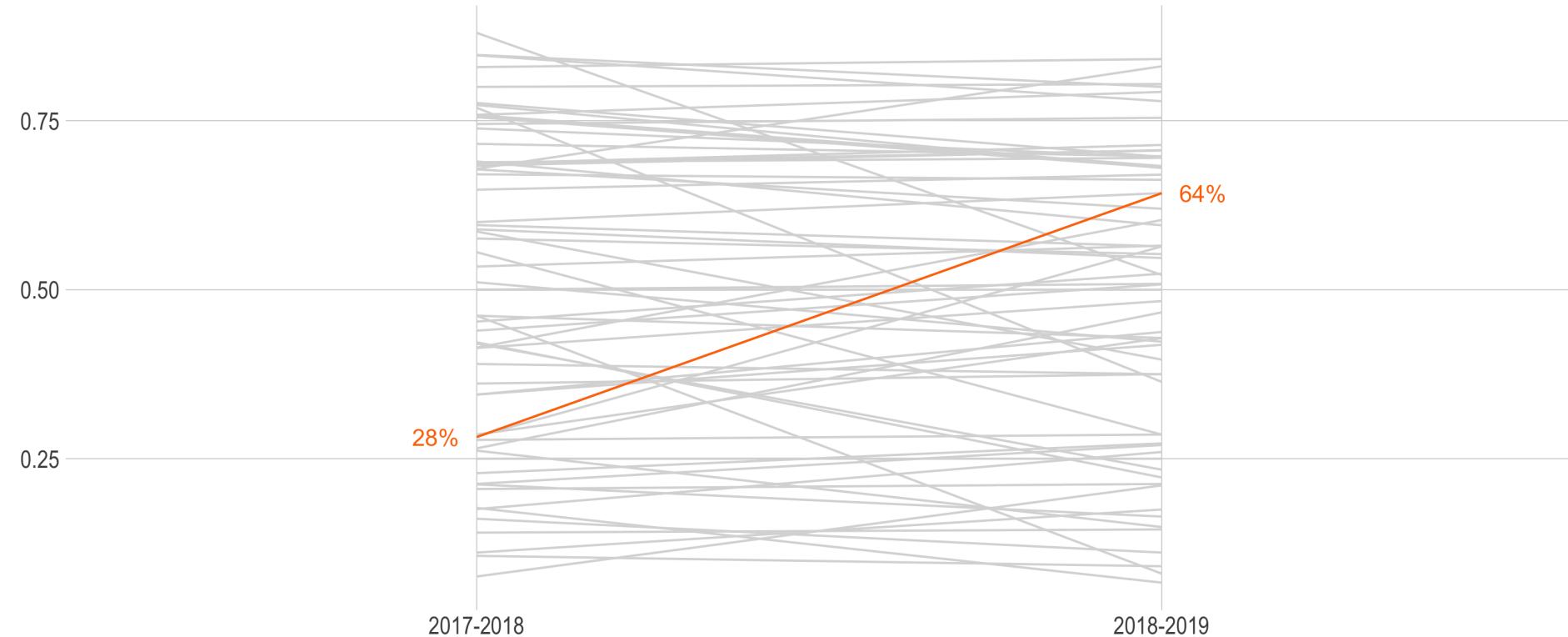
Use Direct Labeling

```
rru_gray <- "#d9d9d9"

third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            nudge_x = c(-0.06, 0.06)) +
  theme_ipsum(axis_title_size = 0) +
  theme(axis.title = element_blank(),
        panel.grid.minor = element_blank())
```



Use Direct Labeling





Use Direct Labeling

```
highlight_school <- third_grade_math_proficiency %>%
  filter(school == "Vestal Elementary School") %>%
  mutate(percent_proficient_display = percent(percent_proficient, accuracy = 1)) %>%
  mutate(percent_proficient_display = case_when(
    year == "2018-2019" ~ str_glue("{percent_proficient_display} of students are proficient")
    TRUE ~ percent_proficient_display
  ))
```

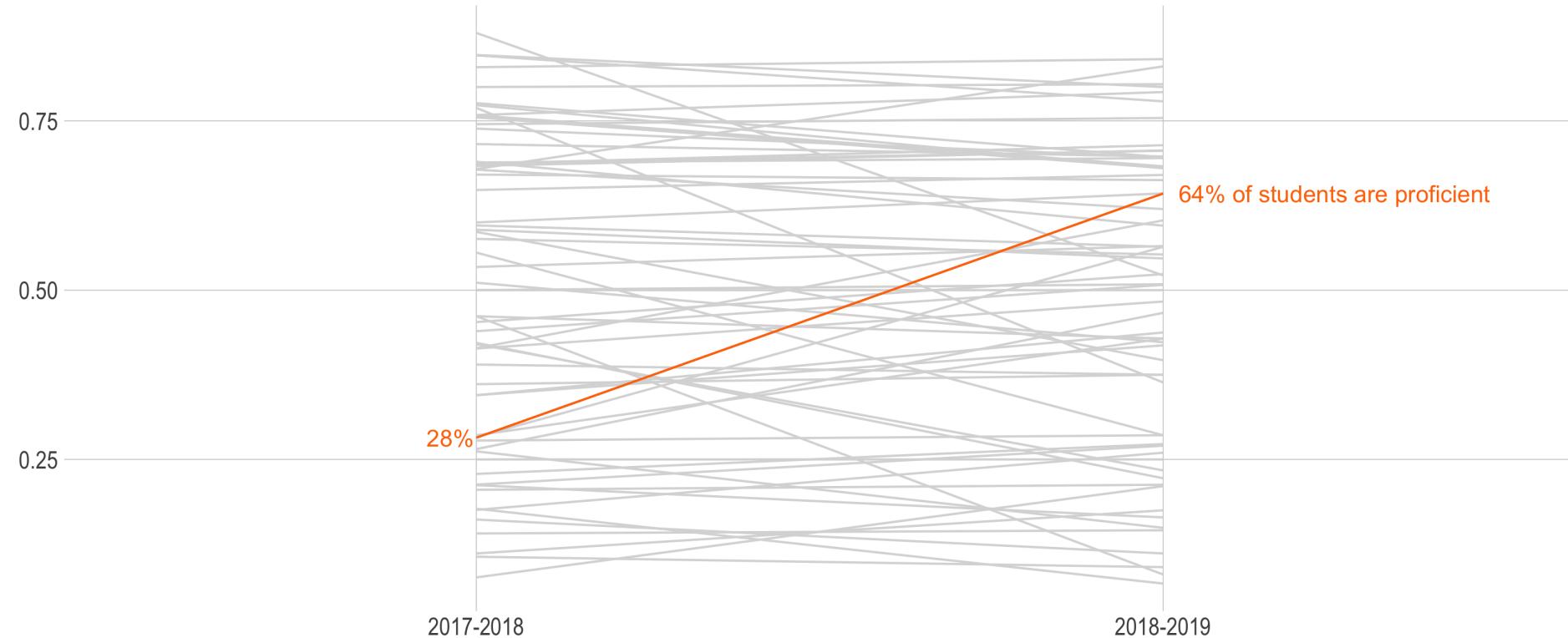


Use Direct Labeling

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  theme_ipsum(axis_title_size = 0) +
  theme(axis.title = element_blank(),
        panel.grid.minor = element_blank())
```



Use Direct Labeling





Your Turn

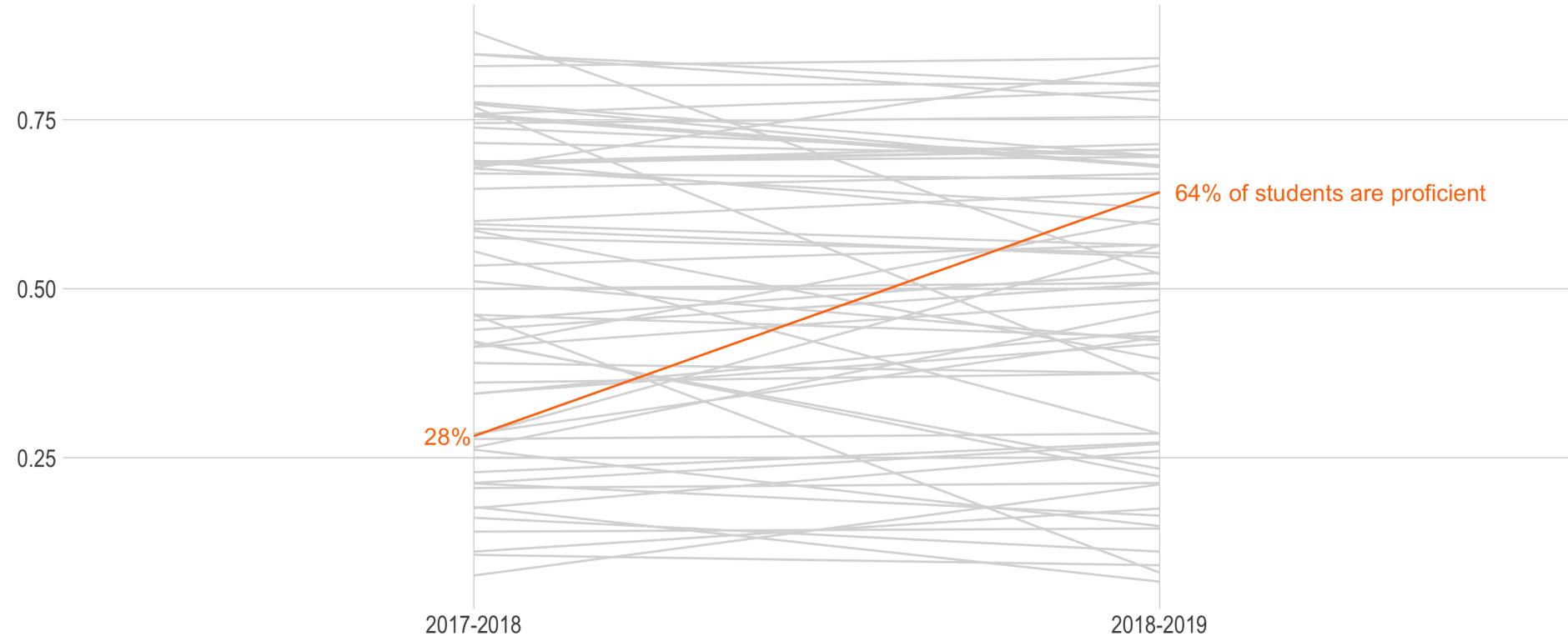
Add text to display the percentage of Hispanic/Latino students in Douglas ESD in 2017-2018 and 2018-2019

A barn owl is the central visual element. It is perched on a dark, textured wooden beam, likely a window frame. The owl has a distinctive heart-shaped face, large dark eyes, and a light-colored body with dark spots. It is looking slightly downwards and to its left. The background is a dark, out-of-focus interior space.

Use Axis Text Wisely



Use Axis Text Wisely



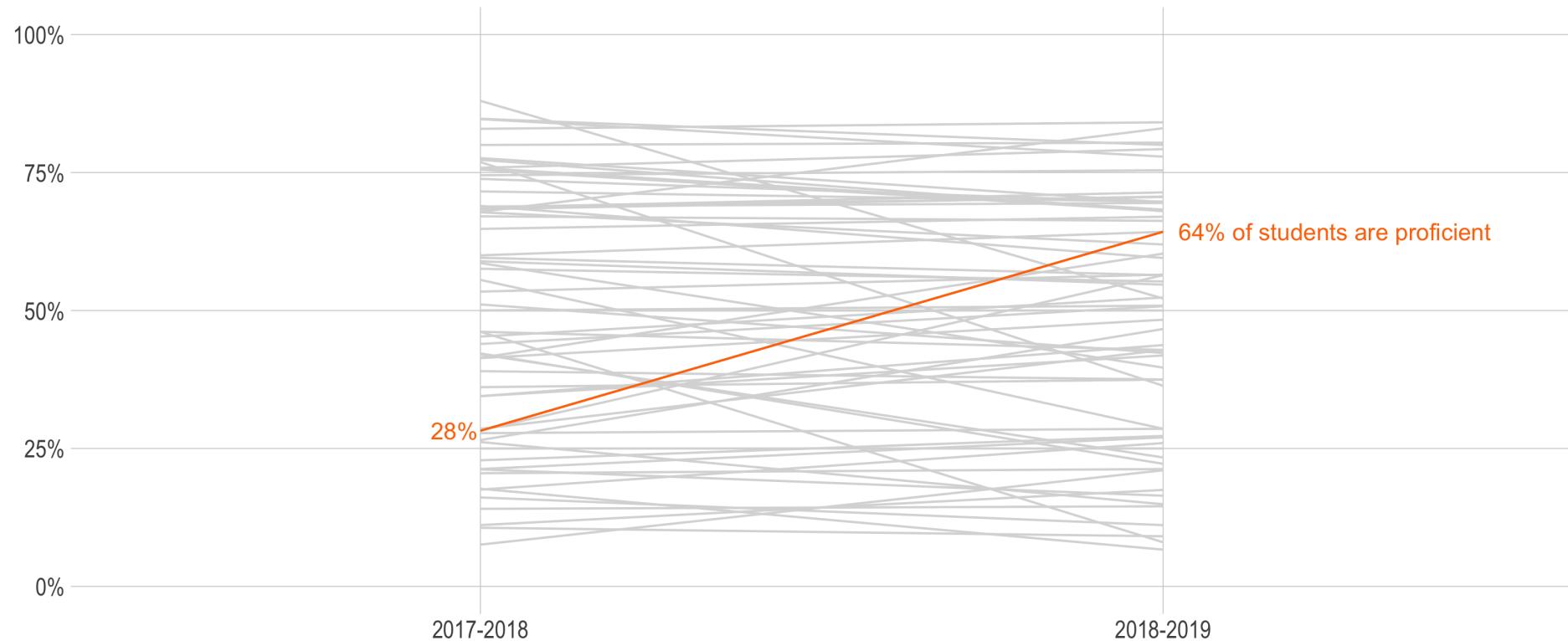


Use Axis Text Wisely

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(labels = percent_format(),
                     limits = c(0, 1)) +
  theme_ipsum(axis_title_size = 0,
              grid = "XY")
```



Use Axis Text Wisely





Your Turn

Make your y axis labels show up as nicely formatted percents using the `percent_format()` function.



Coronavirus
Wash your hands.
Don't touch
your face.

Use Titles to Highlight Findings

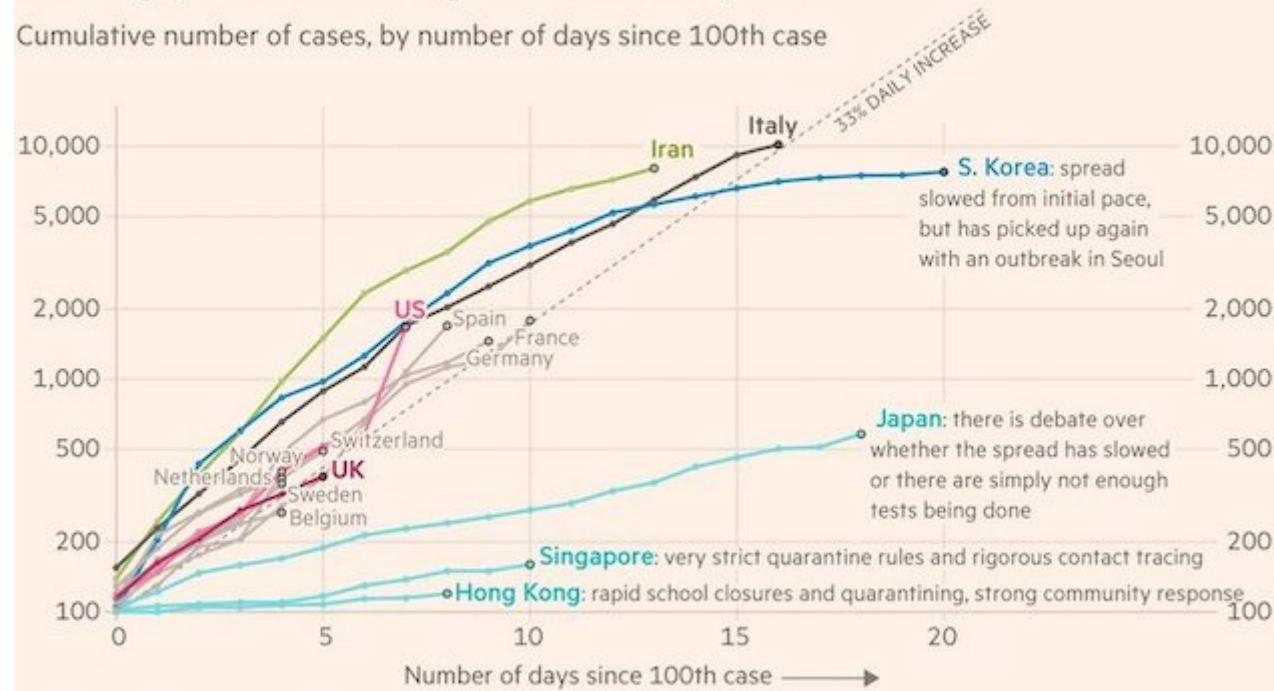
To help prevent infection,
keep your hands away from your
face, eyes, nose, and mouth.

For more information go to:
www.uk/coronavirus



Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



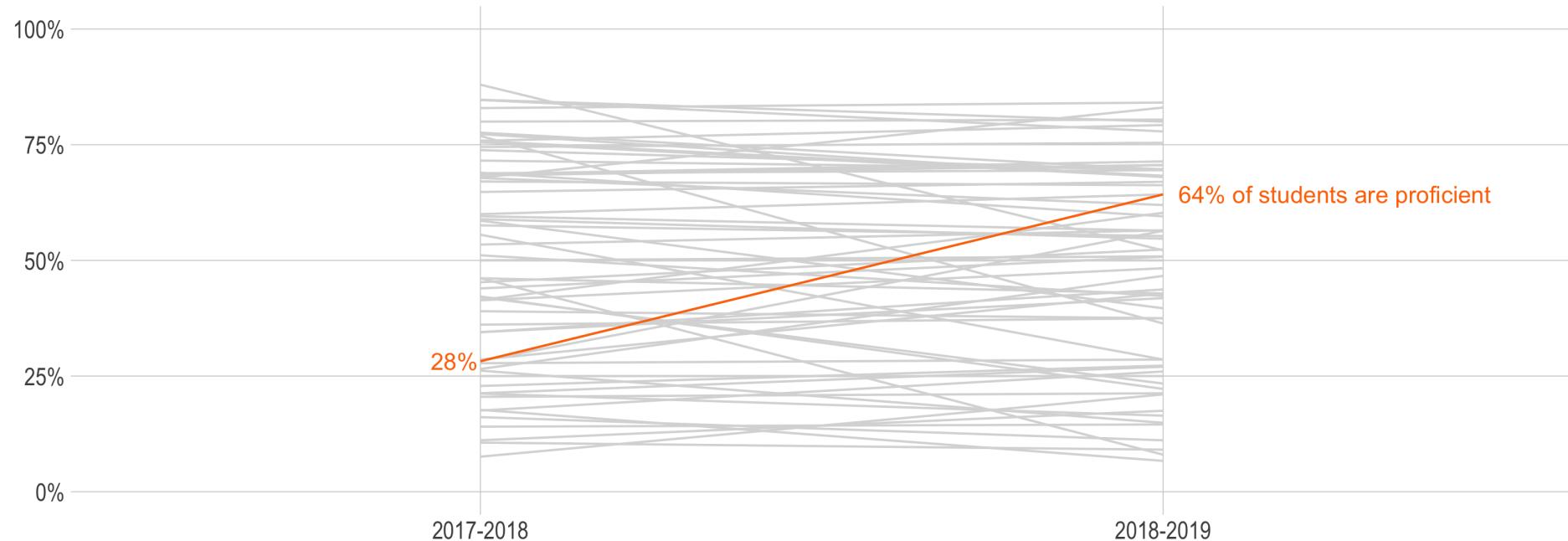
Use Titles to Highlight Findings

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(labels = percent_format(accuracy = 1)) +
  labs(title = "Vestal Elementary School showed large gains in\nthird grade math proficiency scores from 2017-2018 to 2018-2019")
  scale_y_continuous(labels = percent_format(),
                     limits = c(0, 1)) +
  theme_ipsum(axis_title_size = 0,
              grid = "XY")
```



Use Titles to Highlight Findings

Vestal Elementary School showed large gains in third grade math proficiency scores from 2017-2018 to 2018-2019





Your Turn

Add a title to highlight your main finding



Use Color in Titles to Highlight Findings



Use Color in Titles to Highlight Findings

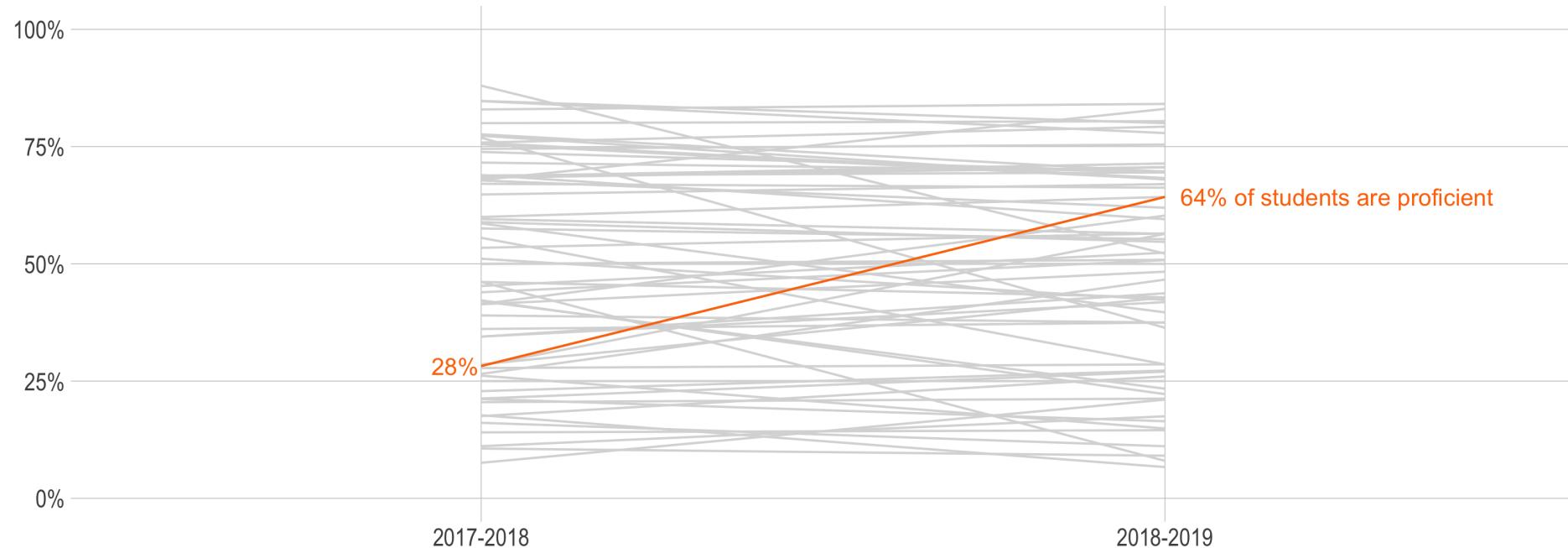
```
library(ggtext)

third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  labs(title = "<span style = 'color: #FF7400;'>Vestal Elementary School</span> showed large gains in<br>third grade math profici
  scale_y_continuous(labels = percent_format(),
                     limits = c(0, 1)) +
  theme_ipsum(axis_title_size = 0,
             grid = "XY") +
  theme(plot.title = element_markdown())
```



Use Color in Titles to Highlight Findings

Vestal Elementary School showed large gains in third grade math proficiency scores from 2017-2018 to 2018-2019





Your Turn

Use color in your title to highlight your main finding. You'll need to:

1. Add HTML in the `labs()` function to add the title
2. Change the `plot.title` argument in the `theme()` function so that it interprets the HTML correctly



istorical average*: Demand
peaks at 11am and 6pm eastern time

March 2020: People
start day later in a
lockdown

April 2020**: Demand is much
smoother through the day

Use Annotations to Explain

Tuesday

Wednesday

Thursday

Friday

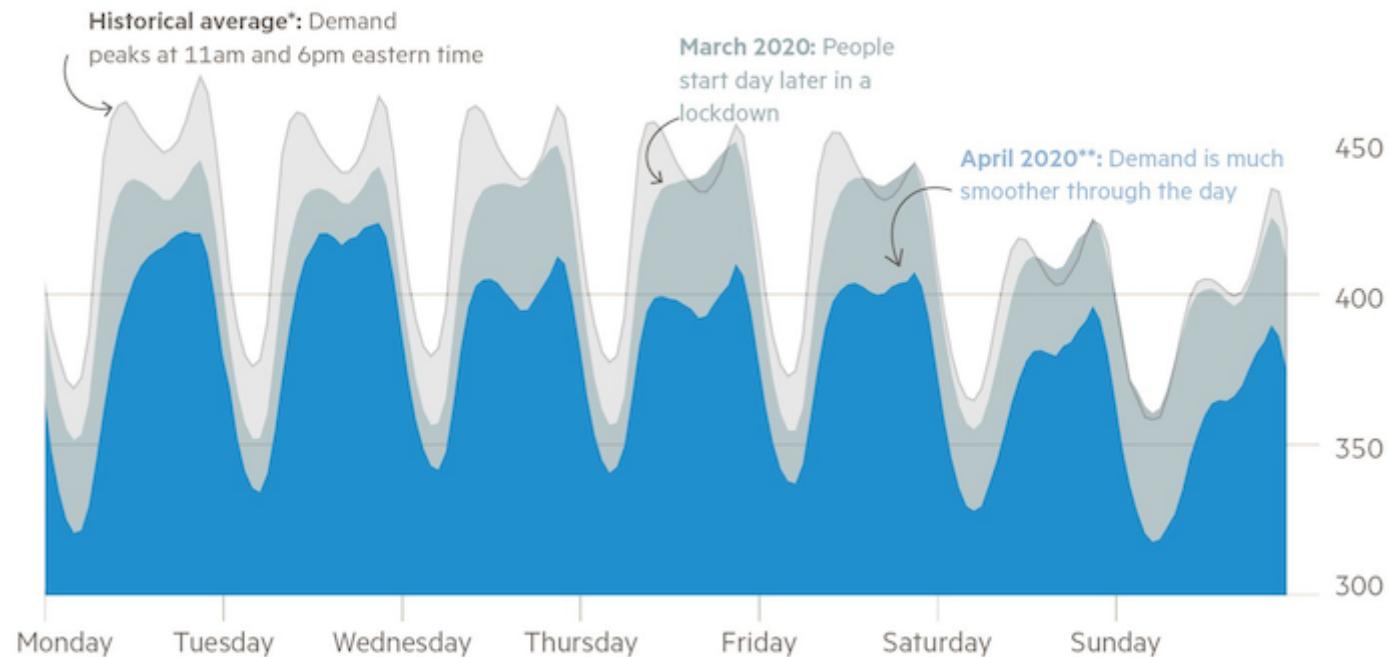
Saturday

Sunday



Coronavirus reduced and changed the pattern of electricity demand

Thousand megawatt-hours, hourly



*Month of March, average 2017-2019, ** March 30 - April 6

Source: US Energy Information Administration, FT research FT graphic: Fan Fei

© FT

Source: [Financial Times](#)



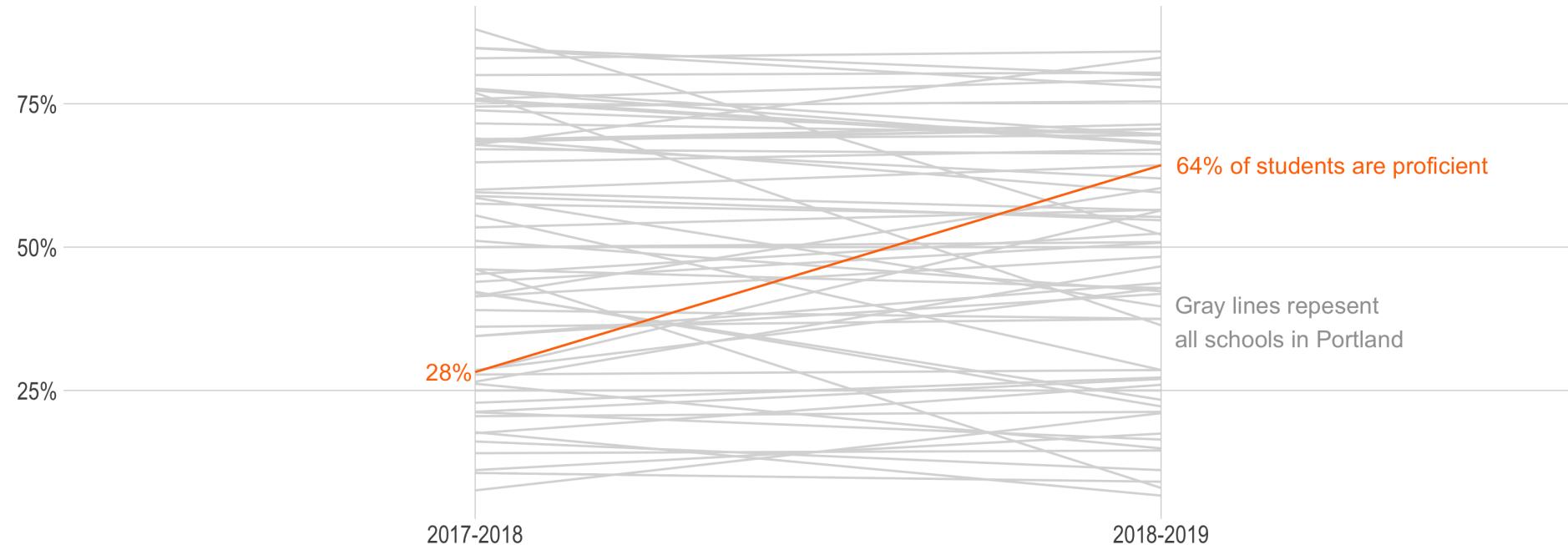
Use Annotations to Explain

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(labels = percent_format(accuracy = 1)) +
  theme_ipsum(axis_title_size = 0,
              grid = "XY") +
  labs(title = "<span style = 'color: #FF7400'>Vestal Elementary School</span> showed large gains in<br>third grade math proficiency",
       theme(plot.title = element_markdown()) +
  annotate("text",
          x = 2.02,
          y = .37,
          label = "Gray lines represent all schools in Portland",
          color = "#A0A0A0",
          hjust = 0)
```



Use Annotations to Explain

Vestal Elementary School showed large gains in third grade math proficiency scores between 2017-2018 and 2018-2019





Your Turn

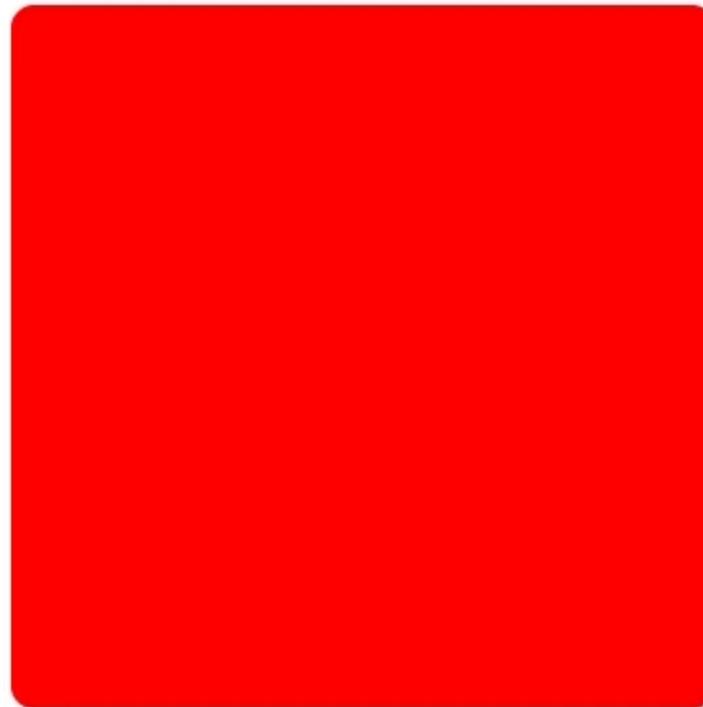
Add an annotation somewhere on your chart to help the reader understand it better



Make it Sparkle

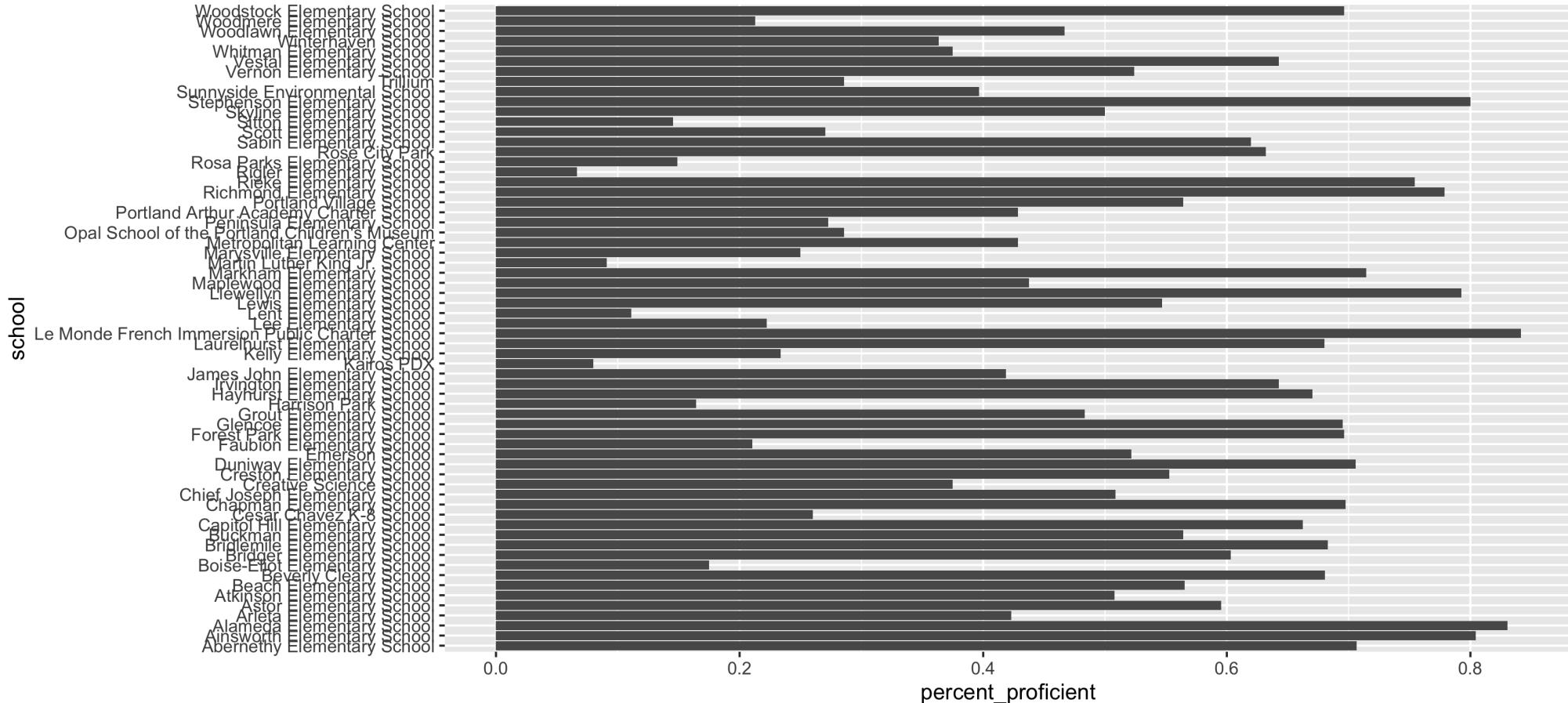


Don't Use Defaults





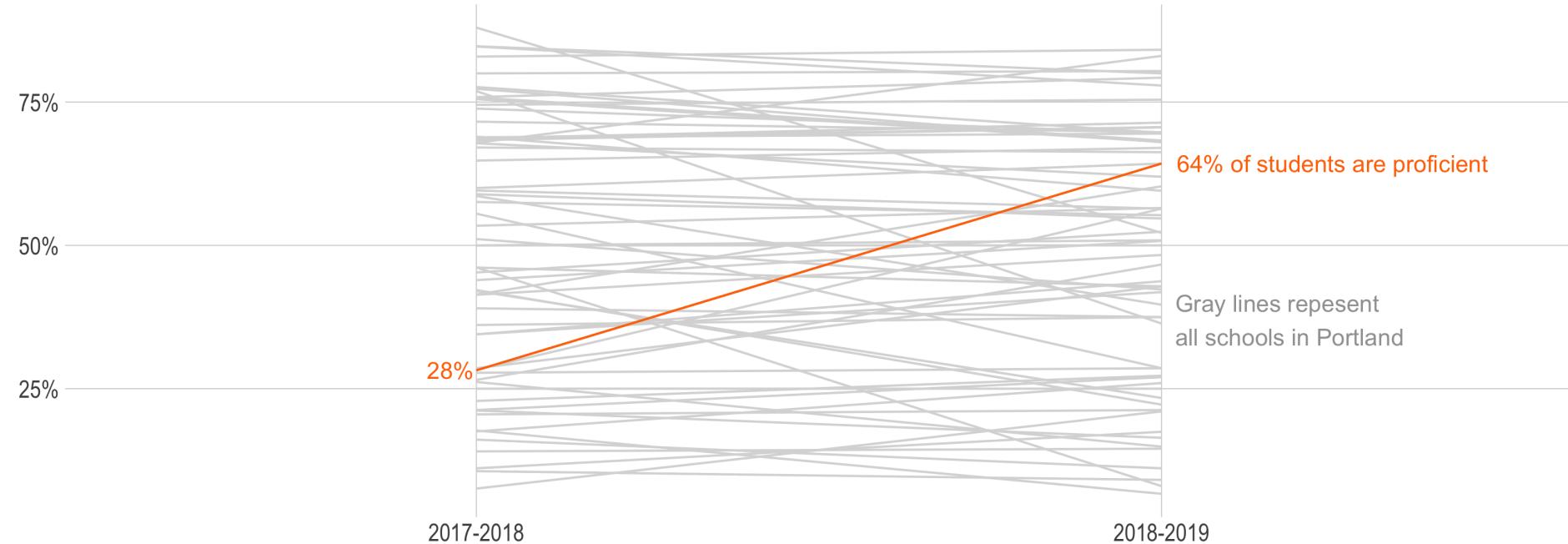
Don't Use Defaults





Tweak Spacing Around Your Plot

Vestal Elementary School showed large gains in third grade math proficiency scores between 2017-2018 and 2018-2019





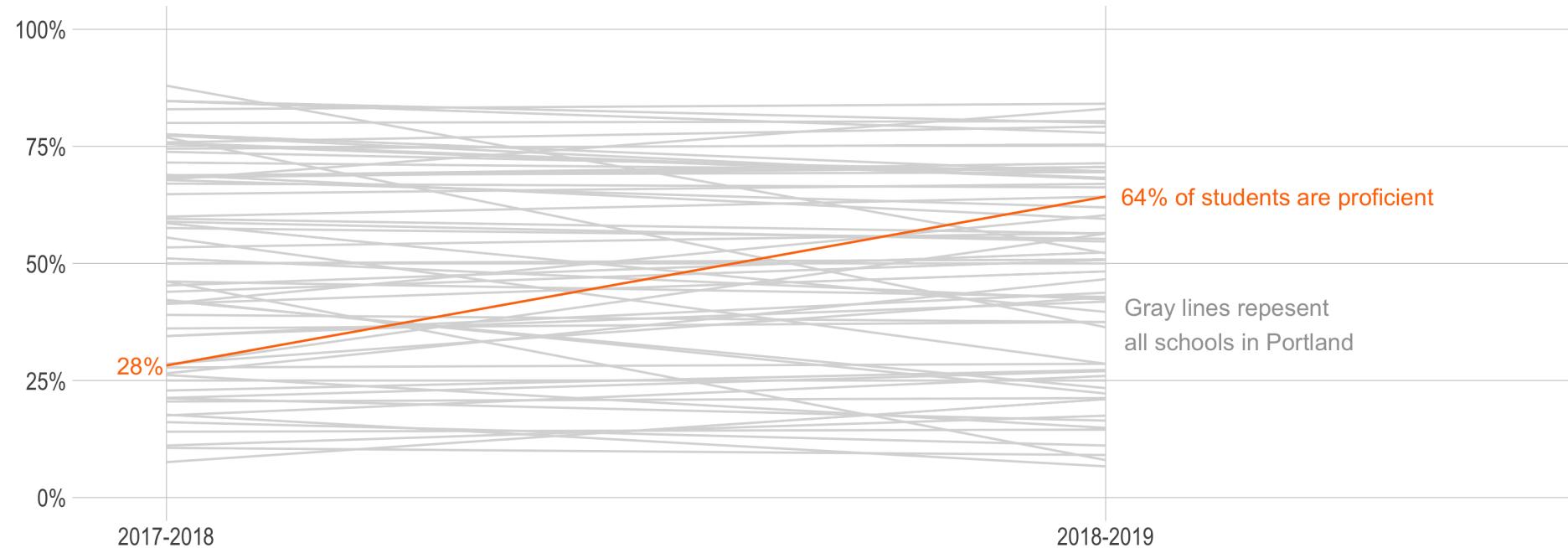
Tweak Spacing Around Your Plot

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(label = percent_format(),
                     limits = c(0, 1)) +
  theme_ipsum(axis_title_size = 0,
              grid = "XY") +
  labs(title = "<span style = 'color: #FF7400'>Vestal Elementary School</span> showed large gains in<br>third grade math proficiency",
       theme(plot.title = element_markdown()) +
  annotate("text",
          x = 2.02,
          y = .37,
          label = "Gray lines represent all schools in Portland",
          color = "#A0A0A0",
          hjust = 0) +
  scale_x_discrete(expand = expansion(add = c(0.1, 0.5)))
```



Tweak Spacing Around Your Plot

Vestal Elementary School showed large gains in third grade math proficiency scores between 2017-2018 and 2018-2019





Your Turn

Use the `expand` argument within the `scale_x_discrete()` function to remove any gaps in your plot



cut

- Fair
- Good
- Very Good
- Premium
- Ideal

Customize Your Theme

15000

10000

5000

0





Make Your Own Custom Theme

```
theme_dk <- function() {  
  theme_ipsum(axis_title_size = 0,  
              grid = "XY") +  
  theme(plot.title = element_markdown())  
}
```



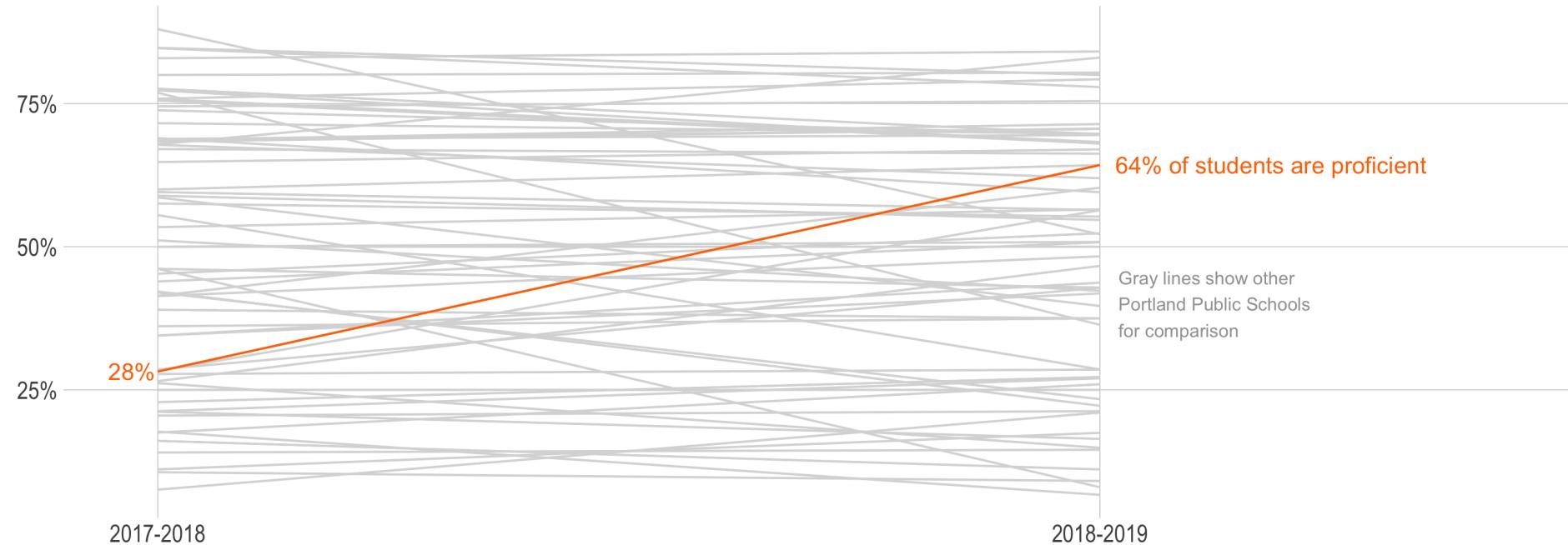
Make Your Own Custom Theme

```
third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(labels = percent_format(accuracy = 1)) +
  labs(title = "<span style = 'color: #FF7400;'>Vestal Elementary School</span> showed large gains in<br>third grade math profici
annotate("text",
        x = 2.02,
        y = 0.4,
        label = "Gray lines show other\nPortland Public Schools\nfor comparison",
        hjust = 0,
        size = 3,
        color = "#A0A0A0") +
  scale_x_discrete(expand = expansion(add = c(0.1, 0.5))) +
  theme_dk()
```



Make Your Own Custom Theme

Vestal Elementary School showed large gains in third grade math proficiency scores from 2017-2018 to 2018-2019





Your Turn

1. Make your own theme by combining elements of the `theme()` function and/or themes from other packages (e.g. `theme_ipsum()`)
2. Add this theme to your plot, removing any code that is now redundant



Customize Your Fonts



Import Custom Fonts

```
library(extrafont)  
font_import(pattern = "Karla")
```



Load Fonts

```
loadfonts()
```

```
fonts()
```



```
theme_dk <- function() {
  theme_ipsum(axis_title_size = 0,
              base_family = "Karla",
              grid = "XY") +
  theme(plot.title = element_markdown())
}

third_grade_math_proficiency %>%
  filter(district == "Portland SD 1J") %>%
  ggplot(aes(x = year, y = percent_proficient,
             group = school)) +
  geom_line(color = rru_gray) +
  geom_line(data = highlight_school,
            inherit.aes = TRUE,
            color = rru_orange) +
  geom_text(data = highlight_school,
            inherit.aes = TRUE,
            aes(label = percent_proficient_display),
            color = rru_orange,
            family = "Karla",
            hjust = c(1.05, -0.05)) +
  scale_y_continuous(label = percent_format(),
                     limits = c(0, 1)) +
  labs(title = "<span style = 'color: #FF7400'>Vestal Elementary School</span> showed large gains in<br>third grade math proficiency in 2017",
       annotate("text",
                x = 2.02,
                y = .37,
                label = "Gray lines represent all schools in Portland",
                color = "#A0A0A0",
                family = "Karla",
                hjust = 0) +
  scale_x_discrete(expand = expansion(add = c(0.1, 0.5))) +
  theme_dk()
```



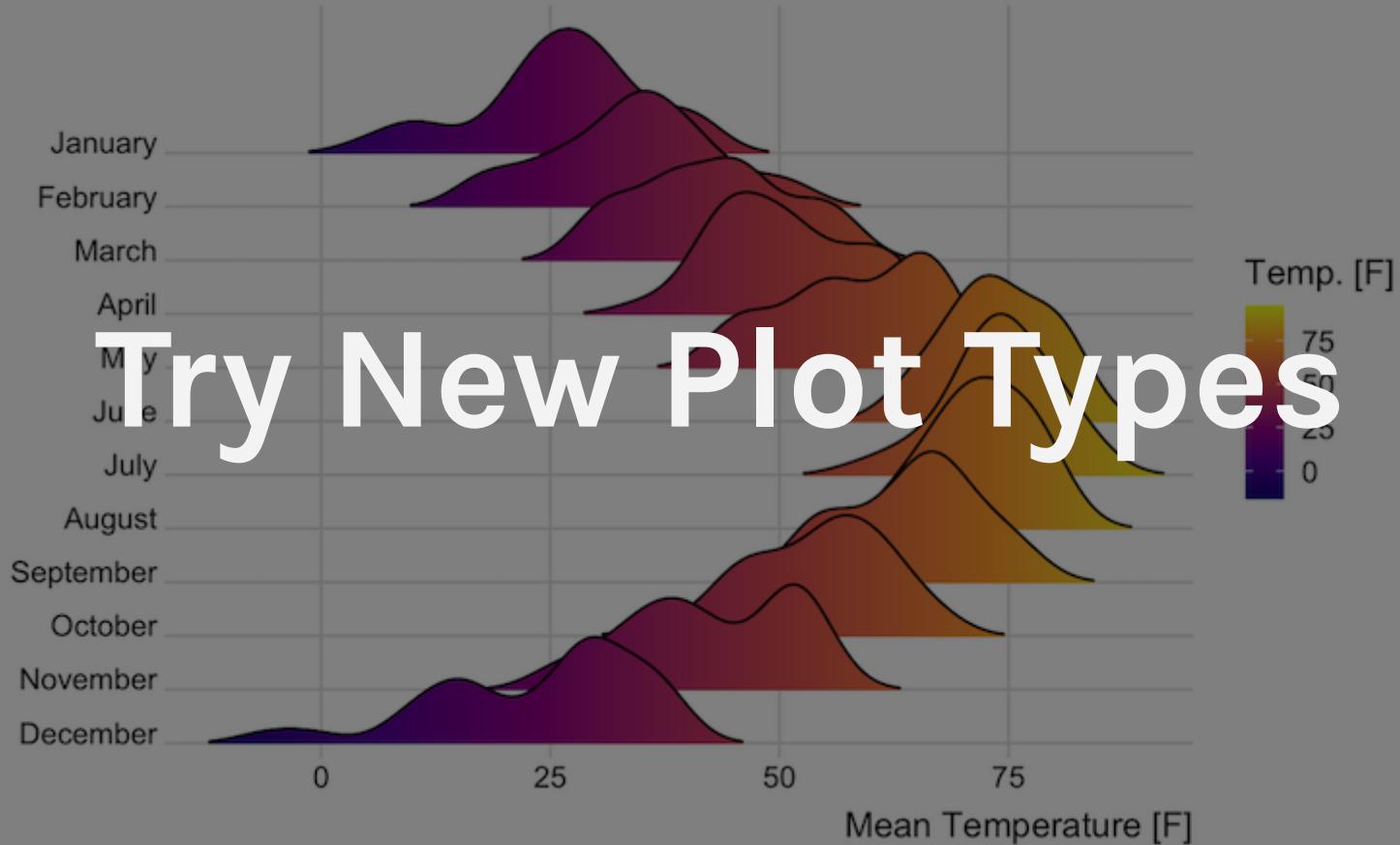
Your Turn

1. Install the `extrafonts` package
2. Run the `import_fonts()` function to make all fonts on your computer available in R (it will take a few minutes)
3. Run the `loadfonts()` function to make sure all fonts are available to R
4. Change all text to use a custom font (you'll have to do this in a few different places)



Temperatures in Lincoln NE

Mean temperatures (Fahrenheit) by month for 2016

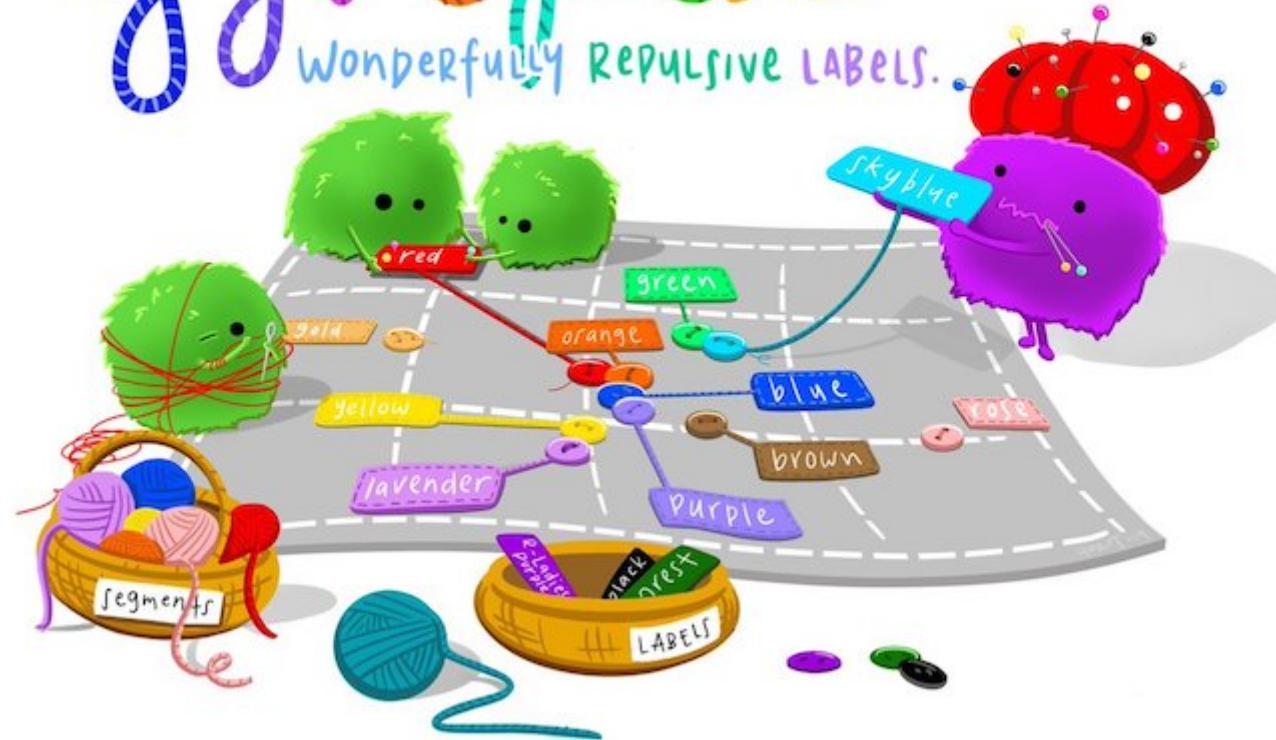


Try New Plot Types



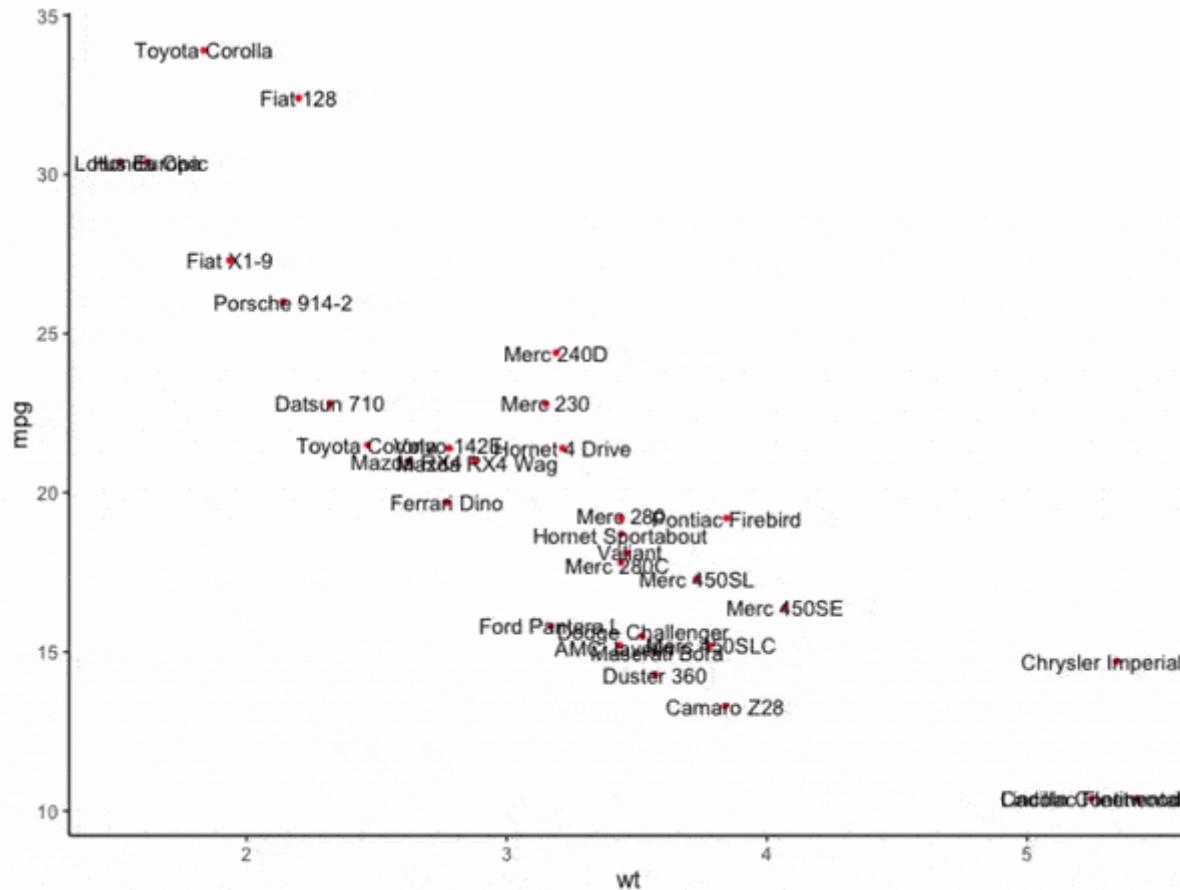
ggrepel

Wonderfully Repulsive LABELS.





ggrepel



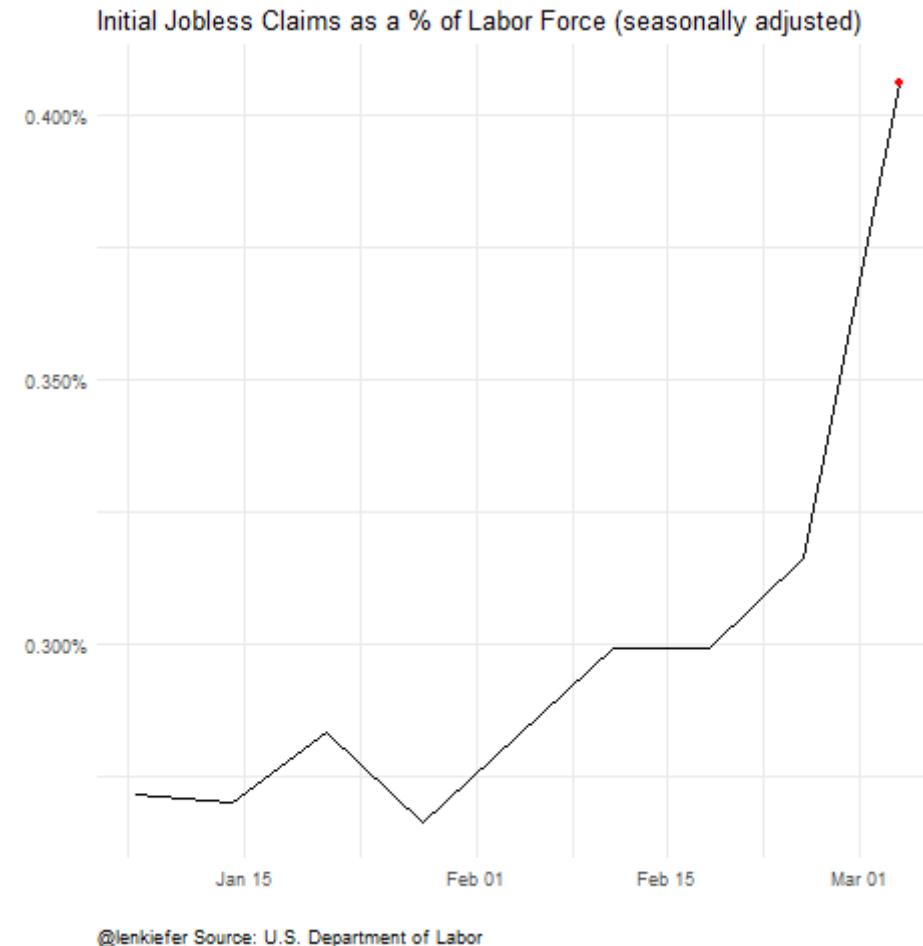


gganimate: ACTION FIGURES!



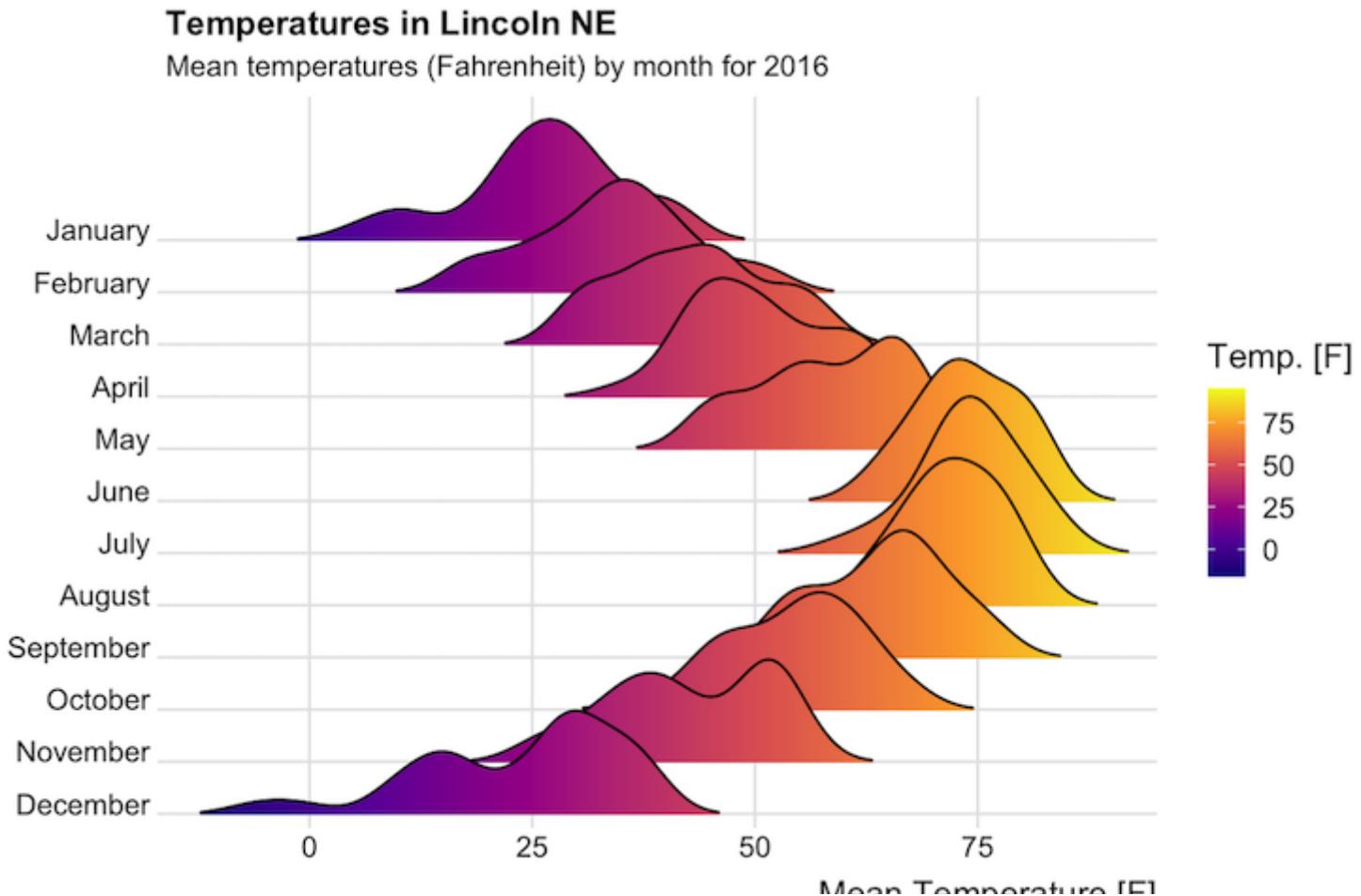


gganimate



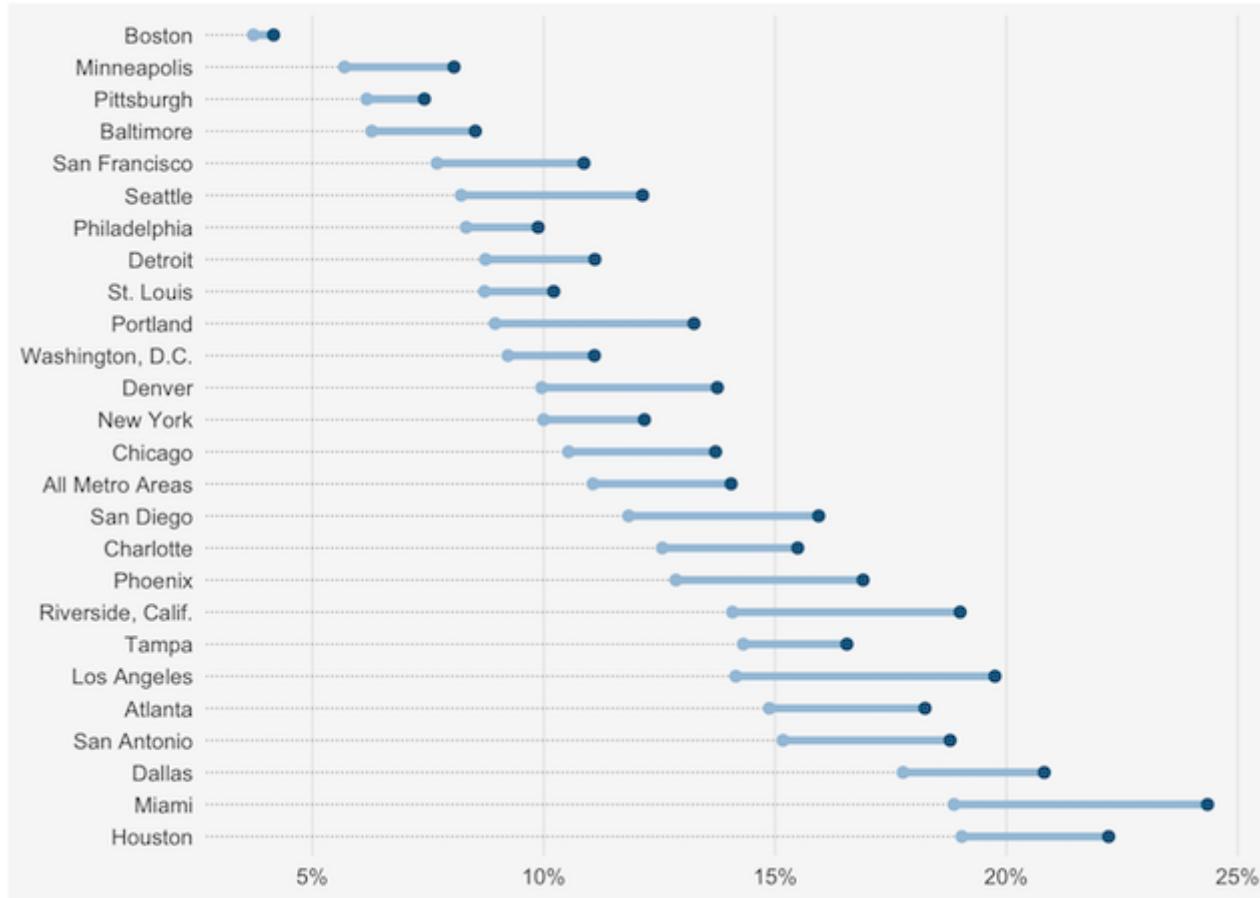


ggridges





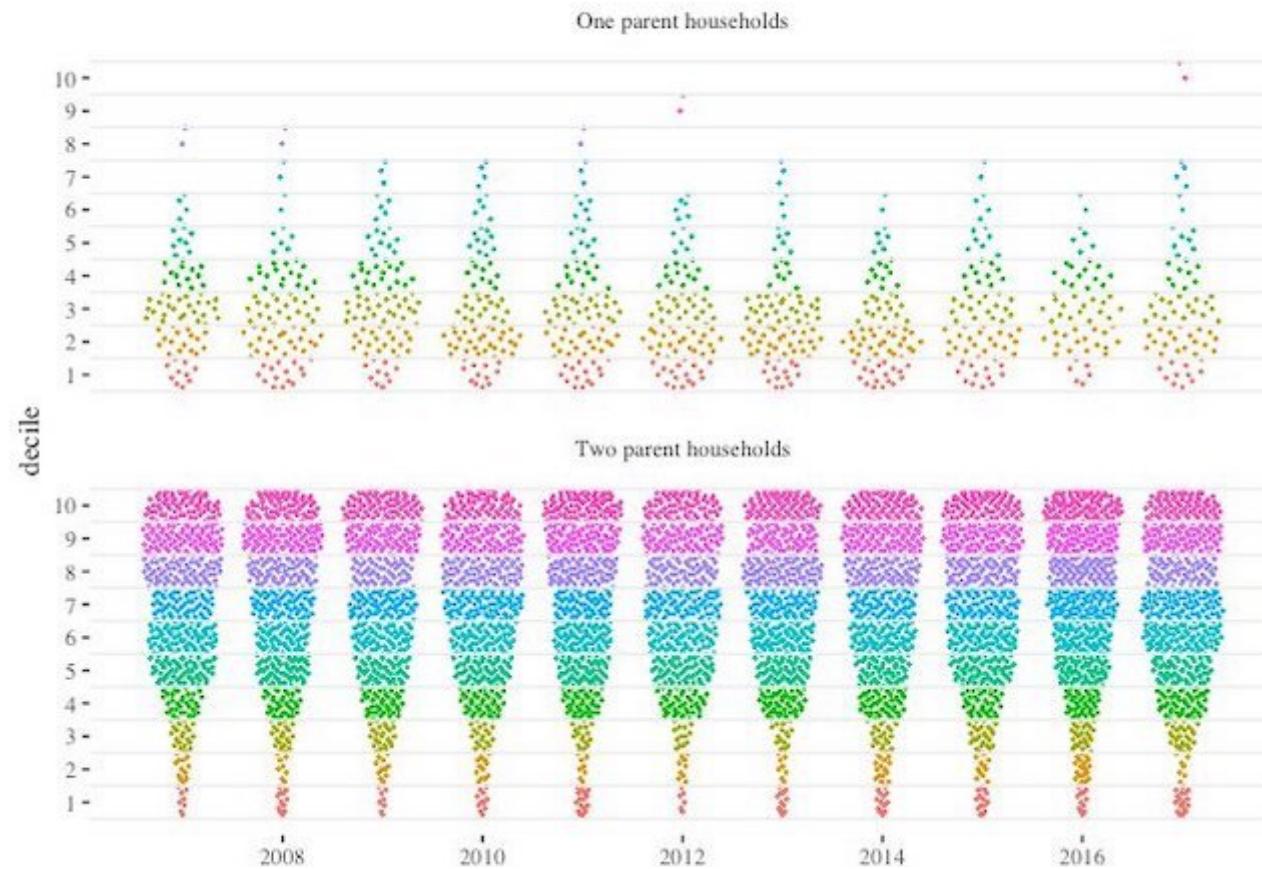
ggalt





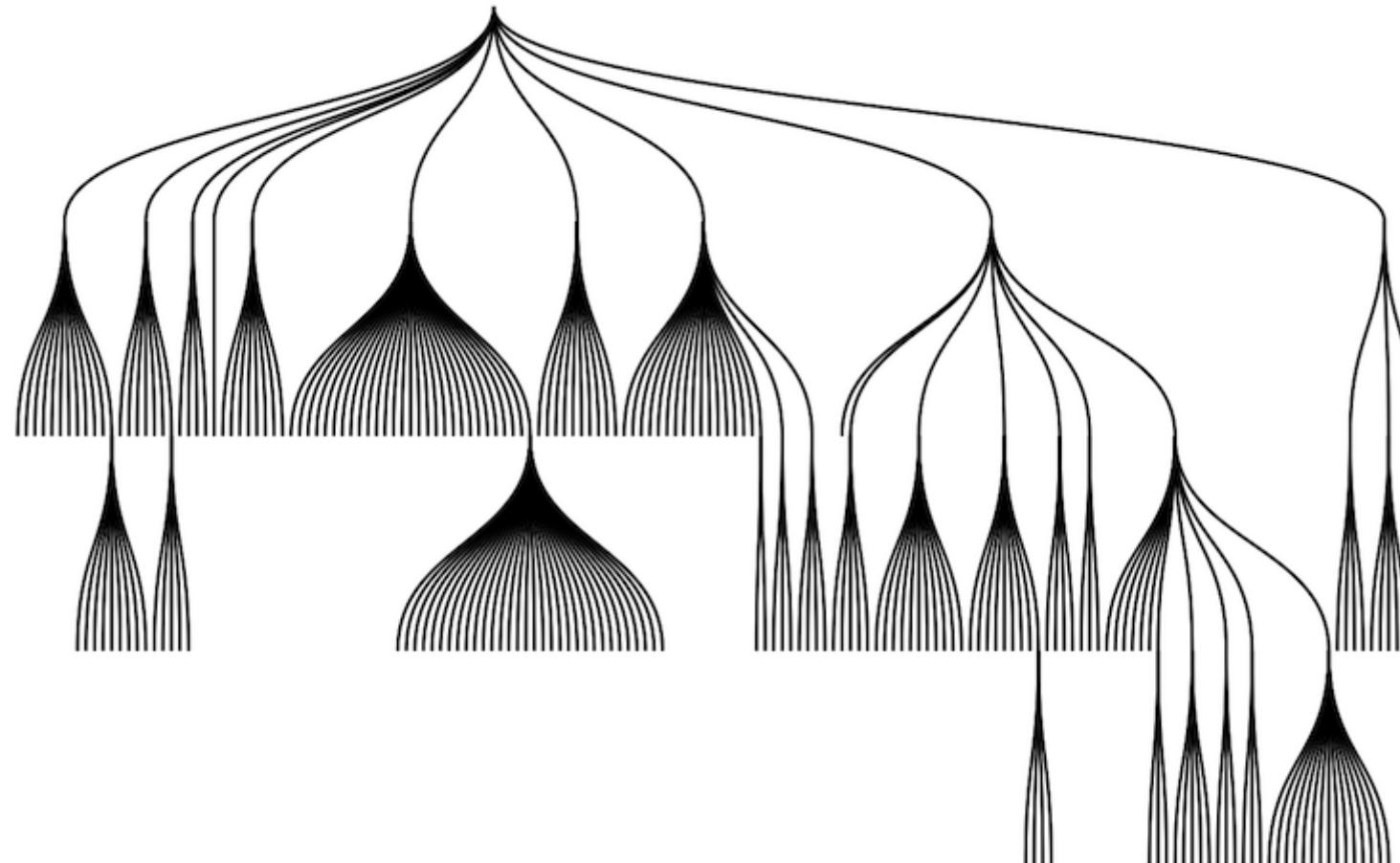
ggbeeswarm

HES income deciles by family type,
1 dot=1000 households





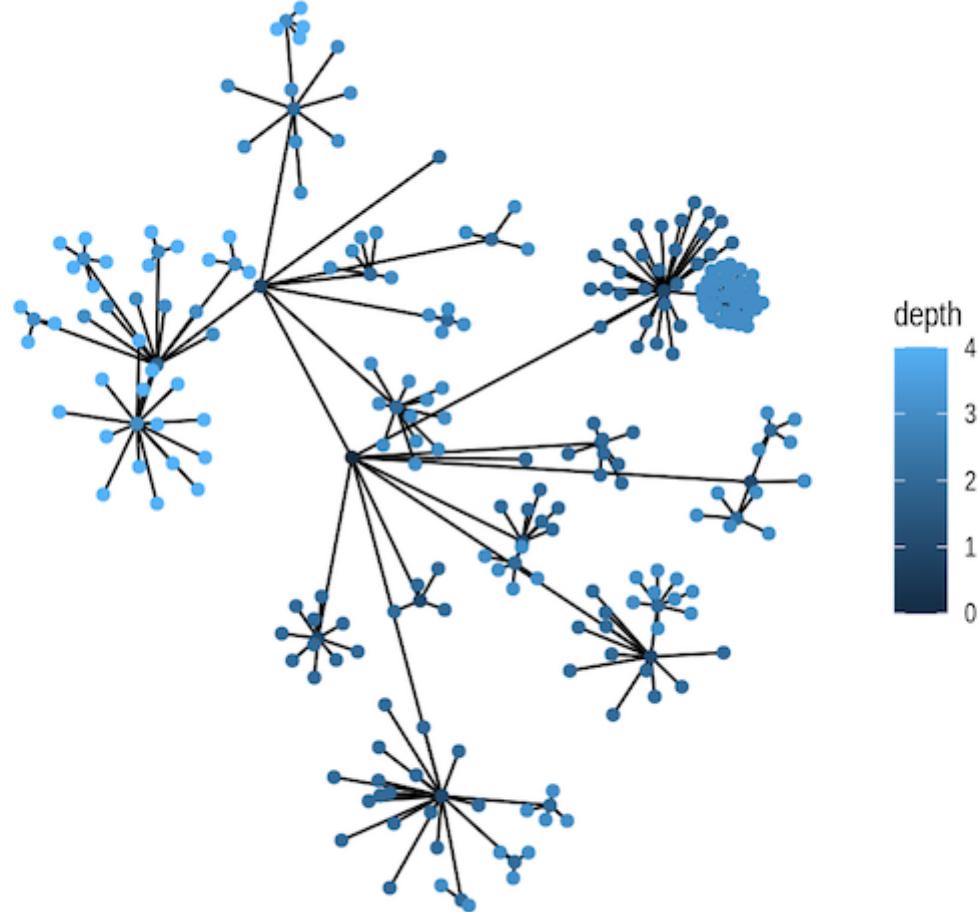
ggraph



R for the Rest of Us

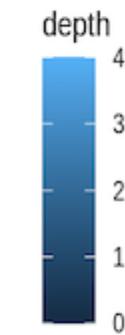
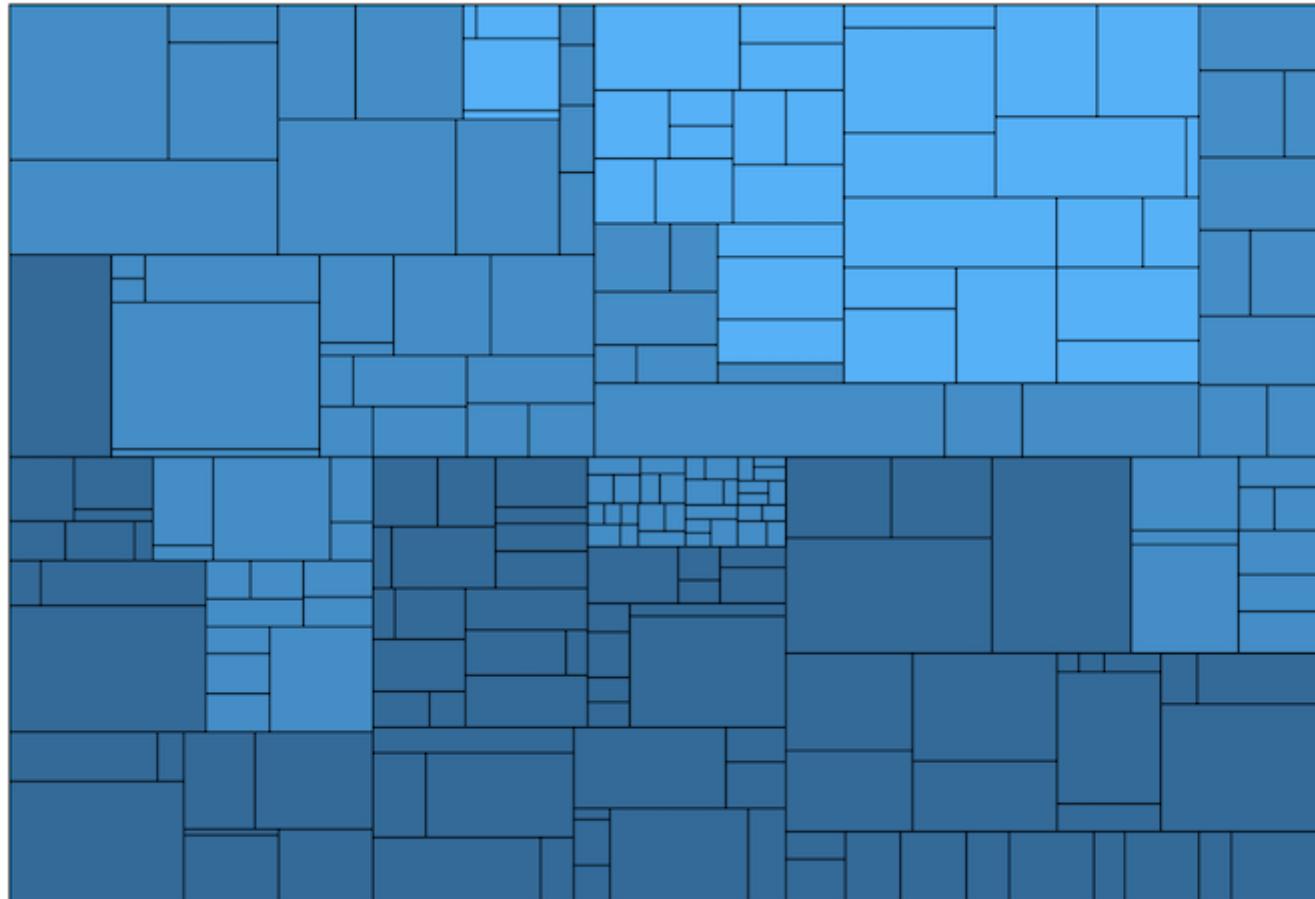


ggraph





ggraph



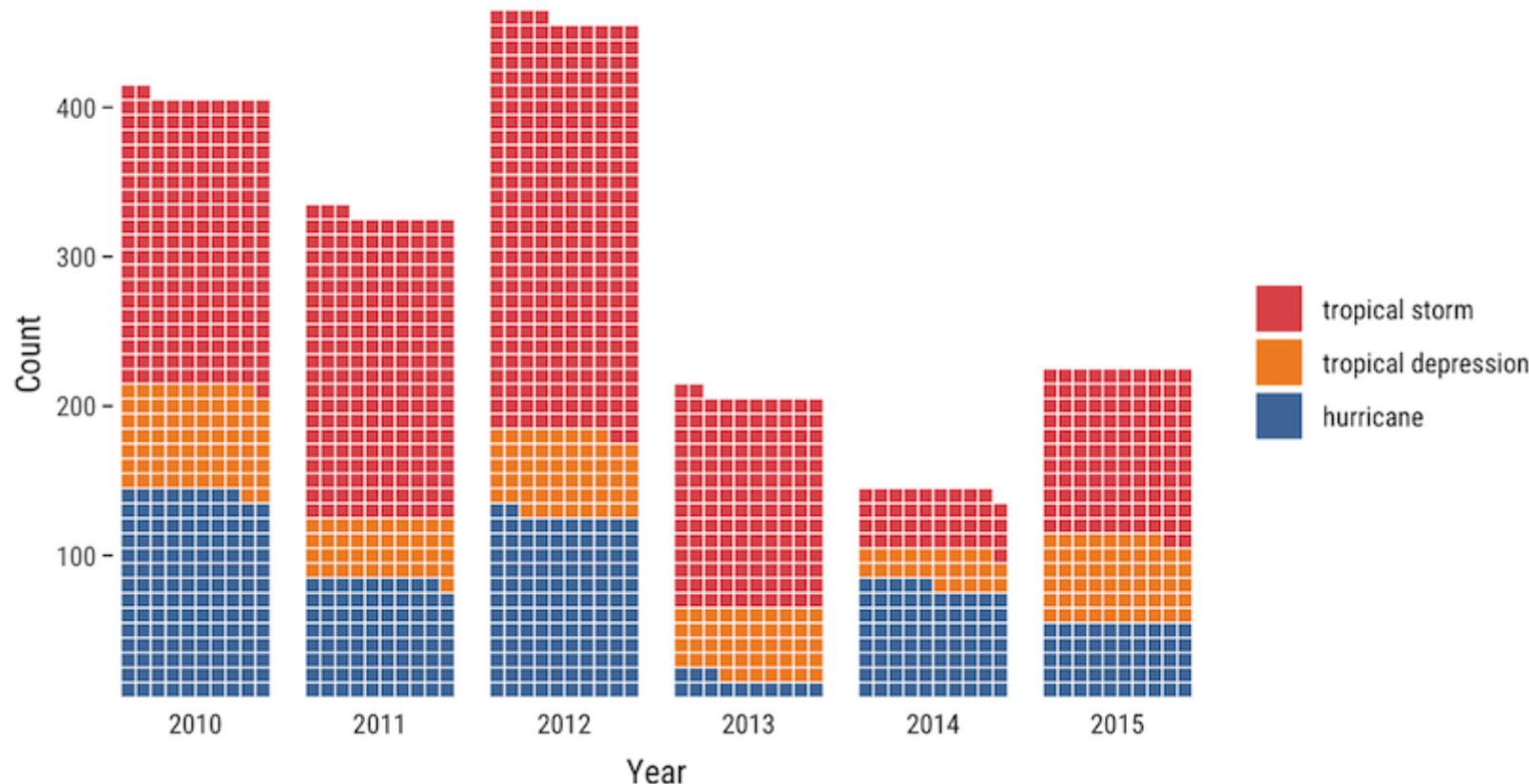
R for the Rest of Us

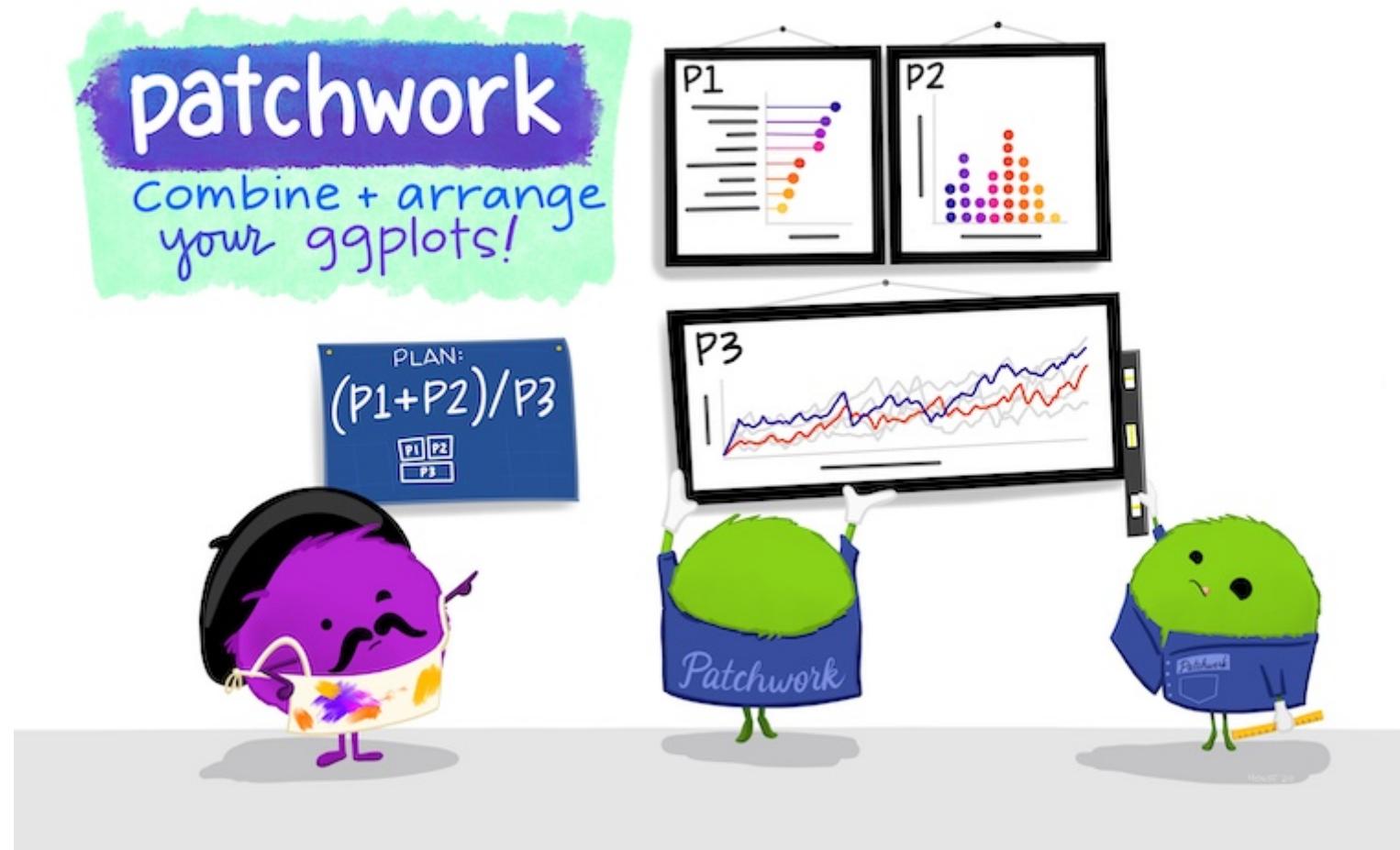


waffle

Faceted Waffle Bar Chart

{dplyr} storms data







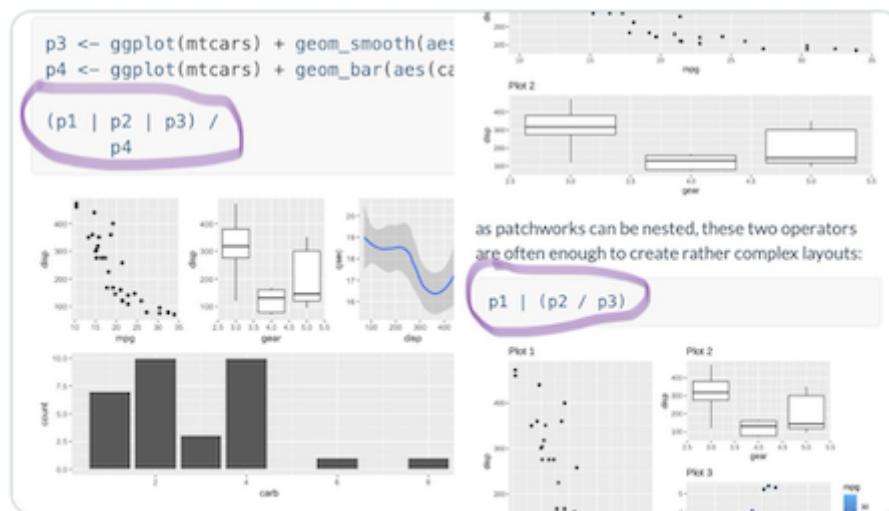
patchwork



Laura Ellis
@LittleMissData

😱 HOW. HAVE. I. NEVER. HEARD. OF.
PATCHWORK?!?!

So easy to combine multiple `#rstats` plots into one image. `#dataviz`

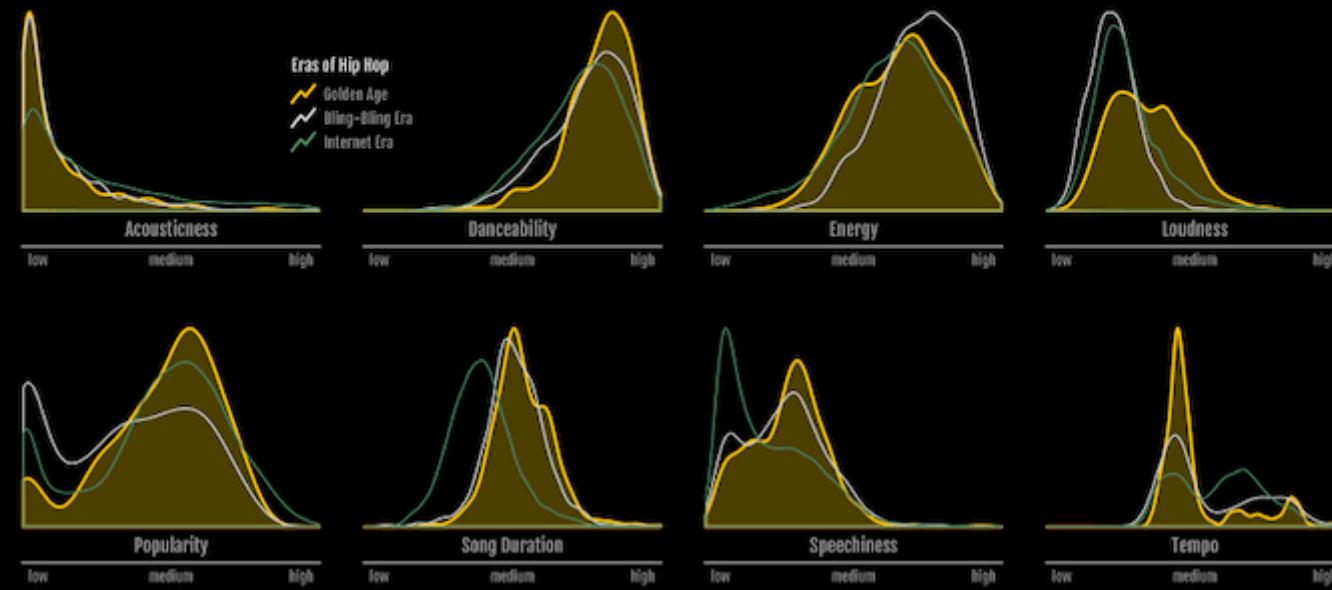




The Golden Age of Hip Hop in the Era of Spotify

It is generally accepted that the **Golden Age of Hip Hop** occurred from the mid 1980s to the mid 1990s. It was then that all the elements of the culture—breaking, graffiti art, DJing, and rap—broke cover to enter the mainstream.

N.W.A., Eric B. & Rakim, Run DMC, and the Beastie Boys allowed rap music to become the culture's crowning glory. With the likes of DMX, Dr. Dre, Eminem, Nelly, and 2Pac all selling albums in their tens of millions, Hip Hop became a game changer, one of the most popular styles in modern music and revolutionized youth culture.

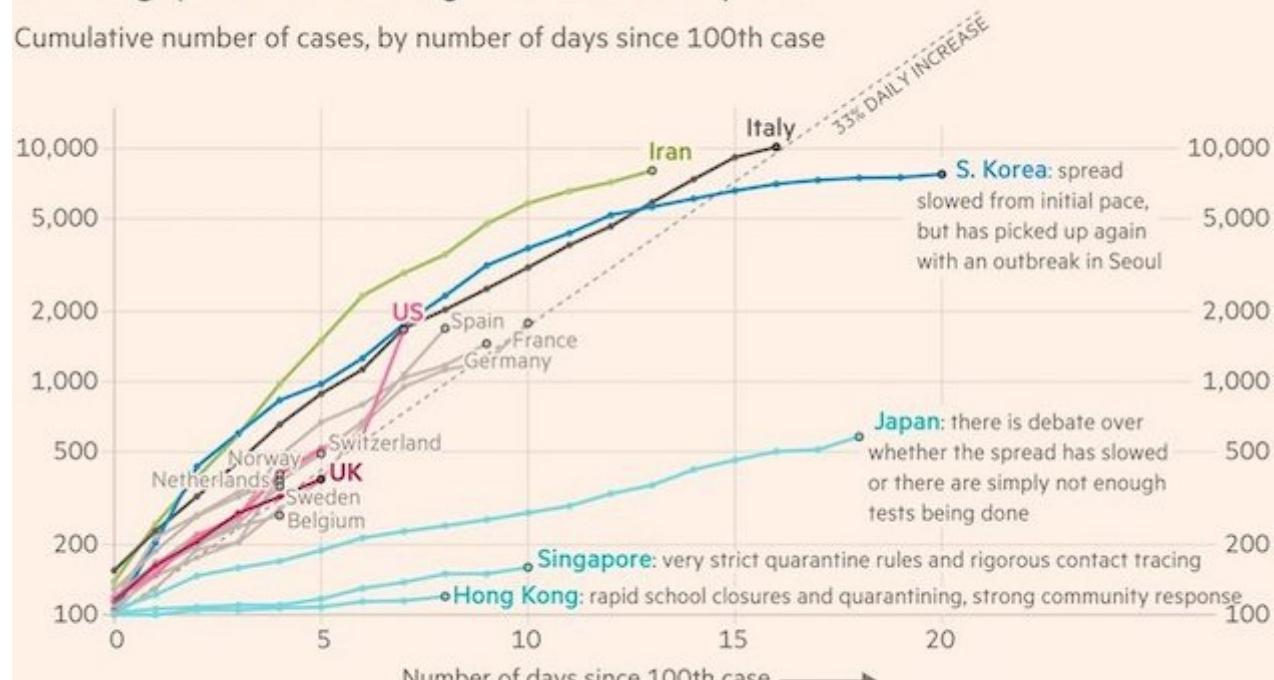




shadowtext

Most western countries are on the same coronavirus trajectory. Hong Kong and Singapore have managed to slow the spread

Cumulative number of cases, by number of days since 100th case



Source: FT analysis of Johns Hopkins University, CSSE

FT graphic: John Burn-Murdoch / @jburnmurdoch

© FT



Your Turn

1. Use one of the packages above to make a unique plot. For example, you might use dumbell plots in the `ggalt` package to show change in the Hispanic/Latino population from 2017-2018 to 2018-2019 for all districts.
2. When you finish your plot, email it to me at david@rfortherestofus.com! I'd love to see what you come up with.