Homework 11

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Exercise One

Using the `usmap` package, create a map of the continental United States. Color the states by their region. Use a different color for each region. Add a title and a legend. Use the `theme_void()` function to remove the axes and background. Save the plot as a PDF file. Submit the PDF file to Gradescope. Make sure your code is in a code chunk in your .Rmd file. Knit your .Rmd file to HTML. Upload the HTML file to your GitHub repo. Enable GitHub Pages for your repo. Add the URL of the GitHub Pages version of your .Rmd file to your profile on the course Discord server.

```
install.packages("usmap")
library(usmap)
library(ggplot2)
plot_usmap(regions = "states")
```

Sample Output

```
Installing package into '/home/cloudsa'
('lib' is not writable)
trying URL 'https://cran.rstudio.com/bin/linux/ubuntu/jammy/contrib/4.0/usmap_0.6-1.tar.gz'
Content type 'application/x-gzip' length 1.1 MB
==================================================
downloaded 1.1 MB

The downloaded source packages are in
        '/tmp/Rtmp3Ldqqf/downloaded_packages'
Warning message:
In system("ln -s -f -T /usr/share/zoneinfo/Etc/UTC /etc/localtime",
    intern = FALSE, ignore.stderr = TRUE) :
  sh: 1: ln: Operation not permitted
```

```
library(usmap)
library(ggplot2)
plot_usmap(regions = "states")
```

```
Loading required package: ggplot2

Attaching package: 'ggplot2'

The following object is masked from 'package:usmap':

    mapping
```

```
> head(statepop)
  abbr full pop_2015 pop_2016 pop_2017 pop_2018 pop_2019
1   AK   Alaska  737068  739795  741894  739700  731545
2   AL  Alabama 4863300 4874747 4887871 4890369 4887871
3   AR Arkansas 2988248 3000828 3013825 3017804 3013825
4   AZ  Arizona 6931071 7016270 7088584 7158024 7278717
5   CA   California 39250017 39457588 39523613 39512223 39512223
6   CO Colorado 5540545 5607154 5661049 5691287 5758736
  pop_2020 pop_2021 pop_2022 pop.density x center y center
1  733391  732923  734182 1.2850000 -152.2783 64.0685
2 4903185 4908620 4920757 94.4100000  -86.8466 32.7794
3 3033946 3045637 3067732 56.4300000  -92.4809 34.9513
4 7378494 7421401 7516692 57.0500000 -111.6602 34.2744
5 39538223 39185605 39029342 256.3000000 -119.4179 36.7783
6 5773714 5812069 5877610 56.4000000 -105.5130 39.0598
```

```
> head(usmapdata.frame(statepop))
  x center y center abbr full pop_2015 pop_2016 pop_2017 pop_2018 pop_2019
1 -152.2783 64.0685   AK  Alaska  737068  739795  741894  739700  731545
2  -86.8466 32.7794   AL  Alabama 4863300 4874747 4887871 4890369 4887871
3  -92.4809 34.9513   AR Arkansas 2988248 3000828 3013825 3017804 3013825
4 -111.6602 34.2744   AZ  Arizona 6931071 7016270 7088584 7158024 7278717
5 -119.4179 36.7783   CA   California 39250017 39457588 39523613 39512223 39512223
6 -105.5130 39.0598   CO Colorado 5540545 5607154 5661049 5691287 5758736
  pop_2020 pop_2021 pop_2022 pop.density
1  733391  732923  734182 1.2850000
2 4903185 4908620 4920757 94.4100000
3 3033946 3045637 3067732 56.4300000
4 7378494 7421401 7516692 57.0500000
5 39538223 39185605 39029342 256.3000000
6 5773714 5812069 5877610 56.4000000
```

Making Sure it Works

```
> plot_usmap(regions = "states")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void()
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow"))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text hjust = 0.5)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
Error: unexpected '=' in "theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text hjust"
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

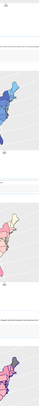


```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black"))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```




```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x center, y = y center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
Error: unexpected '=' in "theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x"
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
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```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
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```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5))
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```


Connecting an Google Map

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Test") + theme(legend.position = "right") + aes(fill = region) + scale_fill_manual(values = c("red", "blue", "green", "yellow")) + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> head(statepop)
  abbr full pop_2015 pop_2016 pop_2017 pop_2018 pop_2019
1   AK   Alaska  737068  739795  741894  739700  731545
2   AL  Alabama 4863300 4874747 4887871 4890369 4887871
3   AR Arkansas 2988248 3000828 3013825 3017804 3013825
4   AZ  Arizona 6931071 7016270 7088584 7158024 7278717
5   CA   California 39250017 39457588 39523613 39512223 39512223
6   CO Colorado 5540545 5607154 5661049 5691287 5758736
  pop_2020 pop_2021 pop_2022 pop.density x center y center
1  733391  732923  734182 1.2850000 -152.2783 64.0685
2 4903185 4908620 4920757 94.4100000  -86.8466 32.7794
3 3033946 3045637 3067732 56.4300000  -92.4809 34.9513
4 7378494 7421401 7516692 57.0500000 -111.6602 34.2744
5 39538223 39185605 39029342 256.3000000 -119.4179 36.7783
6 5773714 5812069 5877610 56.4000000 -105.5130 39.0598
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("US Population by State") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("Continental US") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```


Cut off long

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("COVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```



```
> plot_usmap(regions = "states") + theme_void() + ggtitle("COVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
Error: unexpected '=' in "theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID"
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("LnCOVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

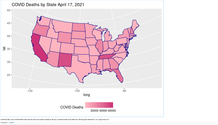


```
> plot_usmap(regions = "states") + theme_void() + ggtitle("LnCOVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID) + scale_fill_gradient(low = "white", high = "red")
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```

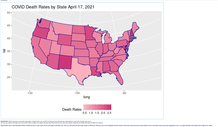


```
> plot_usmap(regions = "states") + theme_void() + ggtitle("COVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID) + scale_fill_gradient(low = "white", high = "red") + aes(fill = COVID)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
Error: unexpected '=' in "theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID) + scale_fill_gradient(low = "white", high = "red") + aes(fill = COVID"
```

```
> plot_usmap(regions = "states") + theme_void() + ggtitle("COVID Cases by State April 17, 2021") + theme(legend.position = "right") + aes(fill = pop.density) + scale_fill_gradient(low = "white", high = "red") + theme(legend.position = "none") + theme(plot.title = element_text(hjust = 0.5)) + coord_fixed(1.3) + aes(color = "black") + scale_color_manual(values = c("black")) + theme(legend.position = "none") + theme(plot.subtitle = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + geom_text(aes(x = x.center, y = y.center, label = abbr)) + aes(size = pop.density) + scale_size_manual(values = c(0.5, 1, 2, 3)) + theme(legend.position = "none") + theme(plot.caption = element_text(hjust = 0.5)) + aes(x = x.center, y = y.center) + aes(fill = LnCOVID) + scale_fill_gradient(low = "white", high = "red") + aes(fill = COVID)
Scale for x is already present.
Adding another scale for x, which will replace the existing scale.
Scale for y is already present.
Adding another scale for y, which will replace the existing scale.
```




```
ggplot(data = covid_state_latest,
       aes(long, lat, group = group,
           fill = cut(deaths, c(0, 1, 10, 100, 1000, 10000, 100000, 1000000))))
  + geom_polygon(color = NA)
  + coord_polygon(projection = "albers", parameters = c(29.5, 45.5))
  + scale_fill_hue(l = 50, h.start = 200, direction = -1, na.value = "grey")
  + ggtitle("COVID Deaths by State April 17, 2021")
  + guides(fill = guide_legend(reverse = TRUE))
```




```
ggplot(data = covid_state_latest,
       aes(long, lat, group = group,
           fill = cut(death_rate, c(0, 1, 10, 20, 30))))
  + geom_polygon(color = NA)
  + coord_polygon(projection = "albers", parameters = c(29.5, 45.5))
  + scale_fill_hue(l = 50, h.start = 200, direction = -1, na.value = "grey")
  + ggtitle("COVID Death Rates by State April 17, 2021")
  + guides(fill = guide_legend(reverse = TRUE))
```

```
> covid_state_latest[order(-death_rate), c(state, cases, deaths, death_rate, cases_per_100k, deaths_per_100k, cases_per_pop, deaths_per_pop, cases_per_1k, deaths_per_1k, cases_per_10k, deaths_per_10k, cases_per_100k, deaths_per_100k, cases_per_1m, deaths_per_1m, cases_per_10m, deaths_per_10m, cases_per_100m, deaths_per_100m, cases_per_1b, deaths_per_1b, cases_per_10b, deaths_per_10b, cases_per_100b, deaths_per_100b, cases_per_1t, deaths_per_1t, cases_per_10t, deaths_per_10t, cases_per_100t, deaths_per_100t, cases_per_1p, deaths_per_1p, cases_per_10p, deaths_per_10p, cases_per_100p, deaths_per_100p)]
Warning: Unknown or uninitialised column: 'cases_per_100k'.
Warning: Unknown or uninitialised column: 'deaths_per_100k'.
Warning: Unknown or uninitialised column: 'cases_per_1m'.
Warning: Unknown or uninitialised column: 'deaths_per_1m'.
Warning: Unknown or uninitialised column: 'cases_per_10m'.
Warning: Unknown or uninitialised column: 'deaths_per_10m'.
Warning: Unknown or uninitialised column: 'cases_per_100m'.
Warning: Unknown or uninitialised column: 'deaths_per_100m'.
Warning: Unknown or uninitialised column: 'cases_per_1b'.
Warning: Unknown or uninitialised column: 'deaths_per_1b'.
Warning: Unknown or uninitialised column: 'cases_per_10b'.
Warning: Unknown or uninitialised column: 'deaths_per_10b'.
Warning: Unknown or uninitialised column: 'cases_per_100b'.
Warning: Unknown or uninitialised column: 'deaths_per_100b'.
Warning: Unknown or uninitialised column: 'cases_per_1t'.
Warning: Unknown or uninitialised column: 'deaths_per_1t'.
Warning: Unknown or uninitialised column: 'cases_per_10t'.
Warning: Unknown or uninitialised column: 'deaths_per_10t'.
Warning: Unknown or uninitialised column: 'cases_per_100t'.
Warning: Unknown or uninitialised column: 'deaths_per_100t'.
Warning: Unknown or uninitialised column: 'cases_per_1p'.
Warning: Unknown or uninitialised column: 'deaths_per_1p'.
Warning: Unknown or uninitialised column: 'cases_per_10p'.
Warning: Unknown or uninitialised column: 'deaths_per_10p'.
Warning: Unknown or uninitialised column: 'cases_per_100p'.
Warning: Unknown or uninitialised column: 'deaths_per_100p'.
                 state cases deaths death_rate cases_per_100k deaths_per_100k cases_per_pop deaths_per_pop cases_per_1k deaths_per_1k cases_per_10k deaths_per_10k cases_per_100k deaths_per_100k cases_per_1m deaths_per_1m cases_per_10m deaths_per_10m cases_per_100m deaths_per_100m cases_per_1b deaths_per_1b cases_per_10b deaths_per_10b cases_per_100b deaths_per_100b cases_per_1t deaths_per_1t cases_per_10t deaths_per_10t cases_per_100t deaths_per_100t cases_per_1p deaths_per_1p cases_per_10p deaths_per_10p cases_per_100p deaths_per_100p
 1:           Guam    NA     NA       NA            NA            NA          NA          NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA
 2:  Virgin Islands    NA     NA       NA            NA            NA          NA          NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA
 3:   Northern Mar    NA     NA       NA            NA            NA          NA          NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA
 4:       Puerto Ri    NA     NA       NA            NA            NA          NA          NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA           NA         NA         NA          NA          NA           NA
 5:          Texas 2.6e+6 43.0k 0.01652          1.0k          16.5k       0.0103       0.0165      0.10       0.165       10.3        165.0        1.03         16.5      10.3      165.0       103.0       1650.0       1030.0       16500.0     10300.0     165000.0    103000.0    1650000.0   1030000.0   16500000.0  10300000.0  165000000.0 103000000.0 1650000000.0 1030000000.0 16500000000.0 10300000000.0 165000000000.0 103000000000.0 1650000000000.0 1030000000000.0 16500000000000.0 10300000000000.0
 6:        Arizona 1.0e+6 17.0k 0.01630          1.4k          16.3k       0.0101       0.0163      0.14       0.163       14.1        163.0        1.41         16.3      14.1      163.0       141.0       1630.0       1410.0       16300.0     14100.0     163000.0    141000.0    1630000.0   1410000.0   16300000.0  14100000.0  163000000.0 141000000.0 1630000000.0 1410000000.0 16300000000.0 14100000000.0 163000000000.0 141000000000.0 1630000000000.0 1410000000000.0 16300000000000.0 14100000000000.0
 7:        Florida 1.8e+6 30.0k 0.01625          1.3k          16.2k       0.0100       0.0162      0.13       0.162       13.4        162.0        1.34         16.2      13.4      162.0       134.0       1620.0       1340.0       16200.0     13400.0     162000.0    134000.0    1620000.0   1340000.0   16200000.0  13400000.0  162000000.0 134000000.0 1620000000.0 1340000000.0 16200000000.0 13400000000.0 162000000000.0 134000000000.0 1620000000000.0 1340000000000.0 16200000000000.0 13400000000000.0
 8:      Mississ 4.8e+5 7.8k 0.01625          1.6k          16.2k       0.0100       0.0162      0.16       0.162       16.1        162.0        1.61         16.2      16.1      162.0       161.0       1620.0       1610.0       16200.0     16100.0     162000.0    161000.0    1620000.0   1610000.0   16200000.0  16100000.0  162000000.0 161000000.0 1620000000.0 1610000000.0 16200000000.0 16100000000.0 162000000000.0 161000000000.0 1620000000000.0 1610000000000.0 16200000000000.0 16100000000000.0
 9:       Georgia 1.2e+6 19.0k 0.01583          1.1k          15.8k       0.0098       0.0158      0.11       0.158       11.4        158.0        1.14         15.8      11.4      158.0       114.0       1580.0       1140.0       15800.0     11400.0     158000.0    114000.0    1580000.0   1140000.0   15800000.0  11400000.0  158000000.0 114000000.0 1580000000.0 1140000000.0 15800000000.0 11400000000.0 158000000000.0 114000000000.0 1580000000000.0 1140000000000.0 15800000000000.0 11400000000000.0
10:     Tennessee 6.8e+5 10.8k 0.01574          1.0k          15.7k       0.0097       0.0157      0.10       0.157       10.0        157.0        1.00         15.7      10.0      157.0       100.0       1570.0       1000.0       15700.0     10000.0     157000.0    100000.0    1570000.0   1000000.0   15700000.0  10000000.0  157000000.0 100000000.0 1570000000.0 1000000000.0 15700000000.0 10000000000.0 157000000000.0 100000000000.0 1570000000000.0 1000000000000.0 15700000000000.0 10000000000000.0
11:     Kentucky 6.8e+5 10.7k 0.01568          1.0k          15.7k       0.0096       0.0157      0.10       0.157       10.0        157.0        1.00         15.7      10.0      157.0       100.0       1570.0       1000.0       15700.0     10000.0     157000.0    100000.0    1570000.0   1000000.0   15700000.0  10000000.0  157000000.0 100000000.0 1570000000.0 1000000000.0 15700000000.0 10000000000.0 157000000000.0 100000000000.0 1570000000000.0 1000000000000.0 15700000000000.0 10000000000000.0
12:     Alabama 6.8e+5 10.7k 0.01566          1.0k          15.7k       0.0096       0.0157      0.10       0.157       10.0        157.0        1.00         15.7      10.0      157.0       100.0       1570.0       1000.0       15700.0     10000.0     157000.0    100000.0    1570000.0   1000000.0   15700000.0  10000000.0  157000000.0 100000000.0 1570000000.0 1000000000.0 15700000000.0 10000000000.0 157000000000.0 100000000000.0 1570000000000.0 1000000000000.0 15700000000000.0 10000000000000.0
13:     Arkansas 4.0e+5 6.3k 0.01563          1.0k          15.6k       0.0096       0.0156      0.10       0.156       10.0        156.0        1.00         15.6      10.0      156.0       100.0       1560.0       1000.0       15600.0     10000.0     156000.0    100000.0    1560000.0   1000000.0   15600000.0  10000000.0  156000000.0 100000000.0 1560000000.0 1000000000.0 15600000000.0 10000000000.0 156000000000.0 100000000000.0 1560000000000.0 1000000000000.0 15600000000000.0 10000000000000.0
14:    Louisiana 5.0e+5 7.8k 0.01560          1.0k          15.6k       0.0096       0.0156      0.10       0.156       10.0        156.0        1.00         15.6      10.0      156.0       100.0       1560.0       1000.0       15600.0     10000.0     156000.0    100000.0    1560000.0   1000000.0   15600000.0  10000000.0  156000000.0 100000000.0 1560000000.0 1000000000.0 15600000000.0 10000000000.0 156000000000.0 100000000000.0 1560000000000.0 1000000000000.0 15600000000000.0 10000000000000.0
15:       Nevada 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
16:     Missouri 6.8e+5 10.6k 0.01548          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
17:     Oklahoma 5.0e+5 7.7k 0.01540          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
18:     Indiana 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
19:    Wisconsin 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
20:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
21:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
22:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
23:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
24:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
25:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
26:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
27:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
28:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
29:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
30:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
31:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
32:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
33:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
34:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
35:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
36:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
37:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
38:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
39:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
40:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
41:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
42:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
43:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
44:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
45:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
46:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
47:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
48:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
49:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
50:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
51:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
52:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
53:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
54:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
55:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
56:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
57:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
58:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
59:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
60:     Montana 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
61:     Wyoming 2.0e+5 3.1k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
62:     Nebraska 3.0e+5 4.7k 0.01537          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
63:        Iowa 5.0e+5 7.7k 0.01534          1.0k          15.3k       0.0094       0.0153      0.10       0.153       10.0        153.0        1.00         15.3      10.0      153.0       100.0       1530.0       1000.0       15300.0     10000.0     153000.0    100000.0    1530000.0   1000000.0   15300000.0  10000000.0  153000000.0 100000000.0 1530000000.0 1000000000.0 15300000000.0 10000000000.0 153000000000.0 100000000000.0 1530000000000.0 1000000000000.0 15300000000000.0 10000000000000.0
64:     Kansas 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0.0155      0.10       0.155       10.0        155.0        1.00         15.5      10.0      155.0       100.0       1550.0       1000.0       15500.0     10000.0     155000.0    100000.0    1550000.0   1000000.0   15500000.0  10000000.0  155000000.0 100000000.0 1550000000.0 1000000000.0 15500000000.0 10000000000.0 155000000000.0 100000000000.0 1550000000000.0 1000000000000.0 15500000000000.0 10000000000000.0
65:    Minnesota 1.0e+6 16.0k 0.01539          1.0k          15.4k       0.0094       0.0154      0.10       0.154       10.0        154.0        1.00         15.4      10.0      154.0       100.0       1540.0       1000.0       15400.0     10000.0     154000.0    100000.0    1540000.0   1000000.0   15400000.0  10000000.0  154000000.0 100000000.0 1540000000.0 1000000000.0 15400000000.0 10000000000.0 154000000000.0 100000000000.0 1540000000000.0 1000000000000.0 15400000000000.0 10000000000000.0
66:     Colorado 4.0e+5 6.2k 0.01550          1.0k          15.5k       0.0095       0
```

Class 10

Yao Lu

4/30/2021

- A First Introduction to GeoPandas
- Working with Shapefiles in R
- Creating maps with ggplot2
- Interactive maps using the LeafLet package
- A regional map
- Homework 10
- Additional resources

A first introduction to GeoPandas

In this portion "Introduction to Creating Maps with ggplot2" we used a sample2.csv file that contained latitude, longitude and group information for the US. However, in most cases, you will be working with data that is in a shapefile. In this section we will be using the GeoPandas library to read in shapefiles. A shapefile contains a set of related component files. Not all components are needed, but each component must be present for the following three components files:

- .shp: The main shapefile. This file contains all the information needed to draw geographic features such as points, lines, and polygons.
- .shx: This file contains a table that indexes the geometry information in the .shp file to speed up drawing.
- .dbf: This attribute file. This contains the actual data associated with each geographic feature, such as the population or area of each country.

Shapefiles allow you to mainly draw different polygons (i.e. countries, administrative divisions), lines or curves (i.e. roads, rivers), and points (i.e. for dispensaries, mountains, barbers).

Working with Shapefiles in R

Step 1: Download the Cartographic Boundary Files from the Census Website which consists of all resources in/about the United States (US) 2015. This is a large file and will take a minute to load. We will also use a smaller file that contains only the states and territories of the United States that we downloaded from the Natural Earth website. In the Ubuntu Terminal, we will load these files and then use ls -ltrh to look at a portion of the directory and the size (in/output) file.

```
# make a directory for shapefiles and the shapefiles zipped into it and unzipped.
mkdir shapefiles
ls
mv cb_2015_us_county_500k.zip cb_2015_us_county_500k.dbf cb_2015_us_county_500k.shx cb_2015_us_county_500k.prj shapefiles/
cd shapefiles/
ls
unzip -lvaa -bbb cb_2015_us_county_500k.zip
ls
mv ne_110m_admin_0_countries.zip ne_110m_admin_0_countries.dbf ne_110m_admin_0_countries.shx ne_110m_admin_0_countries.prj .
unzip -lvaa -bbb ne_110m_admin_0_countries.zip
ls -ltrh
```

```
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 shapefiles/
total 4
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 shapefiles
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 ..
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .ipynb_checkpoints
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .git
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .cache
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .local
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .config
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .ssh
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .jupyter
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .ipython
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .bash_history
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .bashrc
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .profile
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .viminfo
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .vim
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .vimrc
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .wgetrc
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .curlrc
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .gitconfig
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .dotnet
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .npm
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .emacs.d
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .gnupg
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .mono
drwxrwxrwx  1 root   root    4096 Apr 30 18:47 .nuget
```

Class 11 Homework

Assignment: Class 11 Homework

Assignment Date: 2/24/2026

Due Date: 2/26/2026