INTERACTIVE DATA VISUALIZATIONS WITH PLOTLY

Shiny from RStudio™

OUTLINE

- ggplot2
  - Building a plot
  - Refresher
- Plotly
  - ggplotly
  - plotly standalone
  - plotly in shiny

“Most of us need to listen to the music to understand how beautiful it is. But often that’s how we present statistics: we just show the notes, we don’t play the music.”

-Hans Rosling

ggplot2

CREATING A GGPLOT

ggplot2 is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data** set, a **coordinate system**, and geoms—visual marks that represent data points.

To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.

Complete the template below to build a graph.

```
ggplot (data = <DATA>) +                                   required
<GEOM_FUNCTION>(mapping = aes(<MAPPINGS>),
 stat = <STAT>, position = <POSITION> ) +                  Not required, sensible defaults supplied
<COORDINATE_FUNCTION>+
<FACET_FUNCTION>+
<SCALE_FUNCTION>+
<THEME_FUNCTION>
```

ggplot(data = mpg, **aes(**x = cty, y = hwy**))** Begins a plot that you finish by adding layers to. Add one geom function per layer.

aesthetic mappings | data | geom

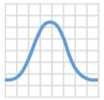
qplot(x = cty, y = hwy, data = mpg, geom = “point"**)** Creates a complete plot with given data, geom, and mappings. Supplies many useful defaults.

TYPES OF PLOTS

ONE VARIABLE continuous

c <- ggplot(mpg, aes(hwy)); c2 <- ggplot(mpg)

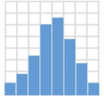
c + geom_area(stat = "bin")
x, y, alpha, color, fill, linetype, size



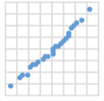
c + geom_density(kernel = "gaussian"**)**
x, y, alpha, color, fill, group, linetype, size, weight

c + geom_dotplot()
x, y, alpha, color, fill

c + geom_freqpoly() x, y, alpha, color, group, linetype, size



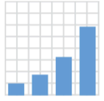
c + geom_histogram(binwidth = 5**)** x, y, alpha, color, fill, linetype, size, weight



c2 + geom_qq(aes(sample = hwy)**)** x, y, alpha, color, fill, linetype, size, weight

discrete

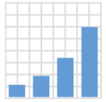
d <- ggplot(mpg, aes(fl))



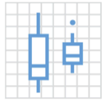
d + geom_bar()
x, alpha, color, fill, linetype, size, weight

discrete x , continuous y

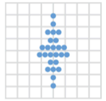
f <- ggplot(mpg, aes(class, hwy))



f + geom_col(), x, y, alpha, color, fill, group, linetype, size



f + geom_boxplot(), x, y, lower, middle, upper, ymax, ymin, alpha, color, fill, group, linetype, shape, size, weight

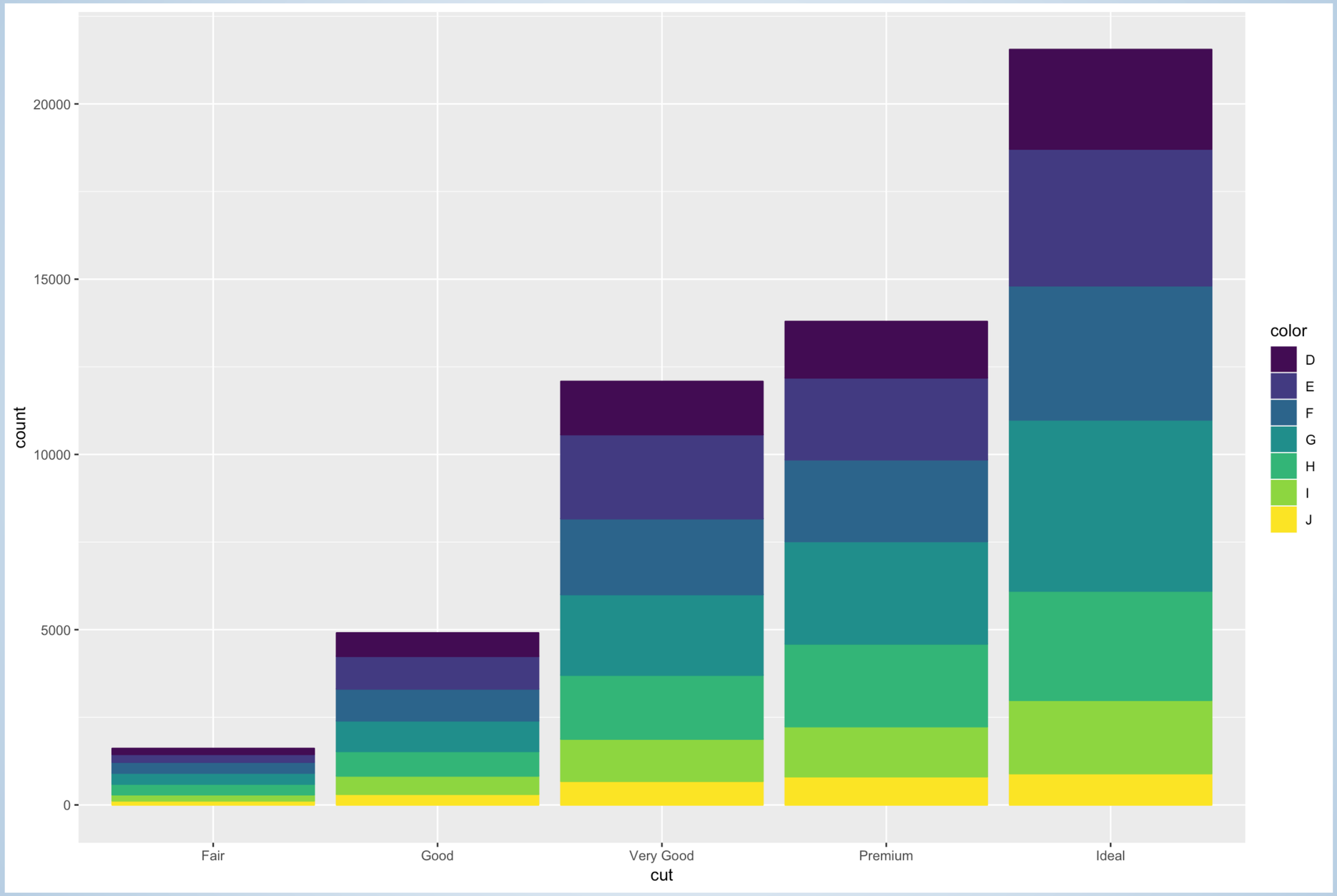


f + geom_dotplot(binaxis = "y", stackdir = "center"**)**, x, y, alpha, color, fill, group

f + geom_violin(scale = "area"**)**, x, y, alpha, color, fill, group, linetype, size, weight

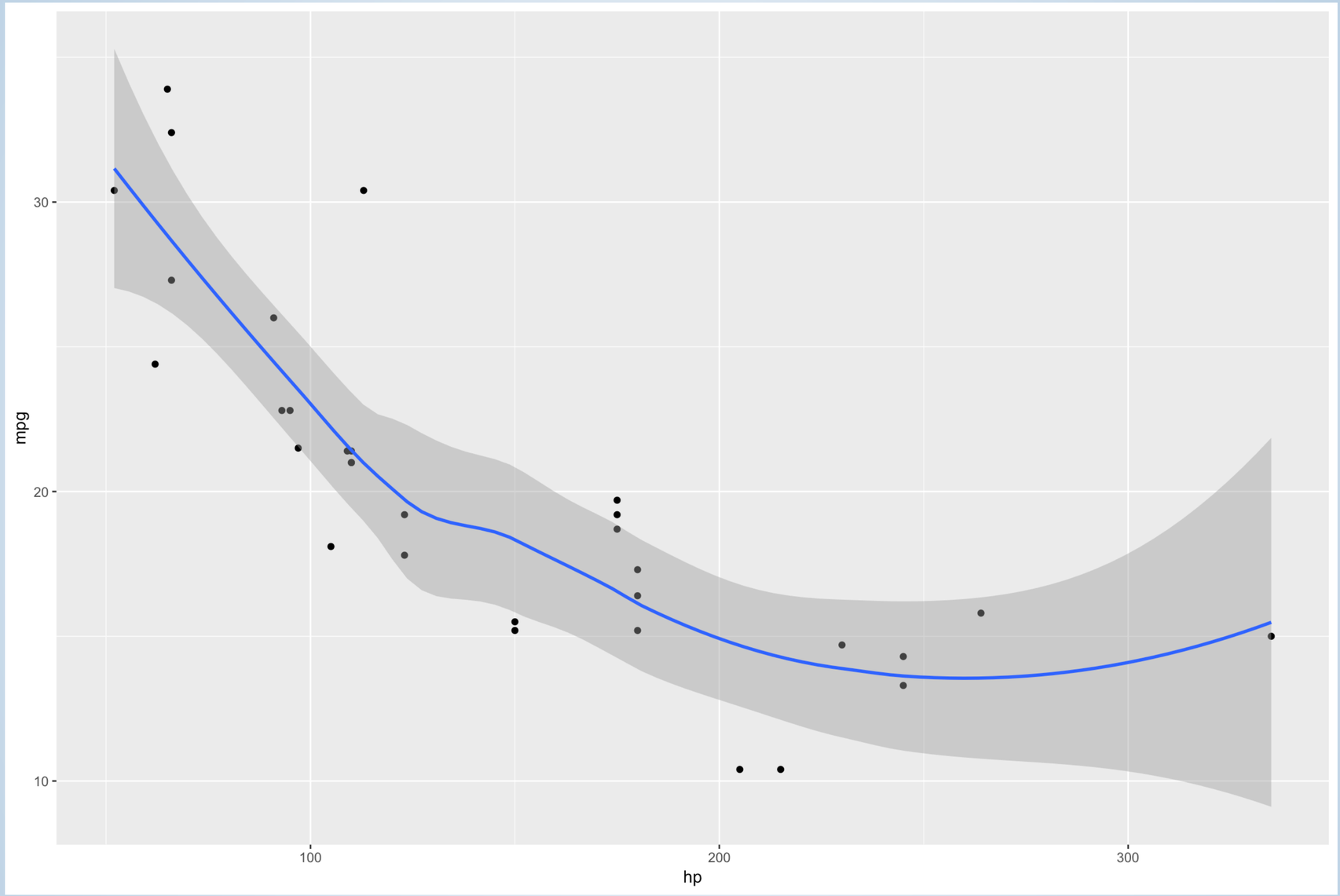
DEMO

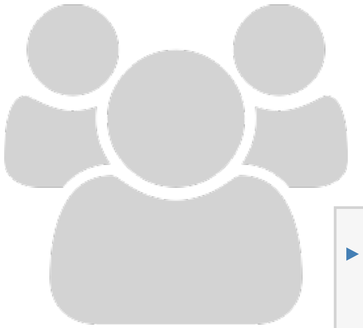
```
ggplot(diamonds, aes(x=cut)) +
  geom_bar()
```


20000
15000
10000
5000
0
count
Fair
Good
Very Good
Premium
Ideal
cut
color
D
E
F
G
H
I
J

DEMO

```
ggplot(mtcars, aes(x = hp, y = mpg)) +
  geom_point() +
  geom_smooth()
```


30
20
10
mpg
100
200
300
hp



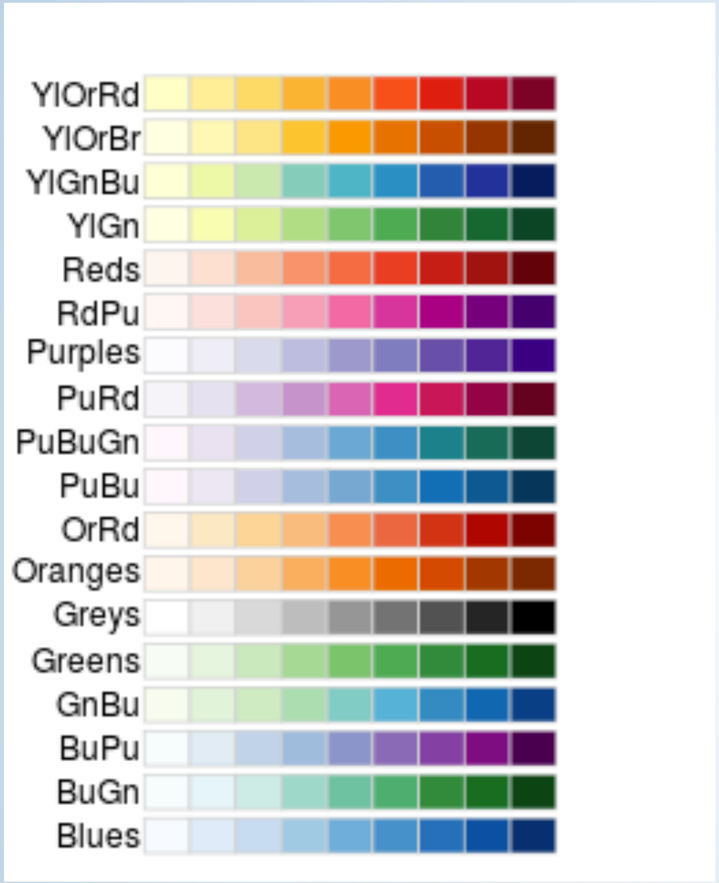
EXERCISE

- Build any plot
  - Use any dataset

3m 00s

DEMO

Are there any other plots from the markdown file you would like to see?



https://colorbrewer2.org/

plotly

ggplotly

DEMO

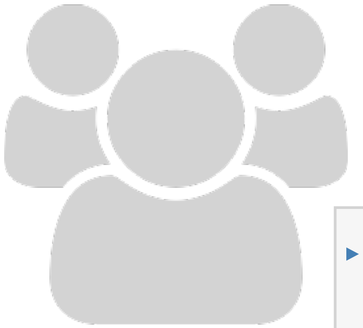
```
ggplotly(
    ggplot(mtcars, aes(x = hp, y = mpg)) +
      geom_point() +
      geom_smooth()
 )
```

DEMO

```
ggplotly(
    ggplot(mtcars, aes(x = hp, y = mpg) +
      geom_point() +
      ggtitle("Car Miles per Gallon by Horse Power") +
      xlab("Horse Power") +
      ylab("MPG"),
    tooltip = c("x", "y")
)
```

DEMO

```
ggplotly(
    ggplot(mtcars, aes(x = hp, y = mpg, text = paste("<b>", rowname, "</b><br>",
      "MPG:", mpg, "<br>Horse Power:", hp))) +
      geom_point() +
      ggtitle("Car Miles per Gallon by Horse Power") +
      xlab("Horse Power") +
      ylab("MPG"),
    tooltip = "text"
)
```



EXERCISE

- Warp your previous ggplot
  - Create a tooltip
  - Run the code and mess around with the user options in plotly

5m 00s

OTHER FEATURES IN PLOTLY

- Users can save their output by clicking the camera
- You can set tooltip popup type ahead of time
  - ie: `%>% layout(hovermode = 'compare')`
- You can even combine two plots
  - ie: `subplot(plot1, plot2, nrows = 2, shareX = TRUE, heights = c(.7, .3))`
- Plotly will recognize most ggplot arguments, but some don't always come over easily.

plotly standalone

Line Plots

```
plot_ly (
  x = c( 1, 2, 3 ),
  y = c( 5, 6, 7),
  type = 'scatter' ,
  mode = 'lines' )
```

Bubble Charts

```
plot_ly (
  x = c( 1, 2, 3 ),
  y = c( 5, 6, 7 ),
  type = 'scatter' ,
  mode = 'markers' ,
  size = c( 1, 5, 10 ),
  marker = list(
      color = c( 'red', 'blue' ,
      'green' )))
```

Scatter Plots

```
plot_ly (
  x = c( 1, 2, 3 ),
  y = c( 5, 6, 7 ),
  type = 'scatter' ,
  mode = 'markers' )
```

Heatmaps

```
plot_ly (
  z = volcano ,
  type = 'heatmap' )
```

Bar Charts

```
plot_ly (
  x = c( 1, 2, 3),
  y = c( 5, 6, 7),
  type = 'bar' ,
  mode = 'markers' )
```

Area Plots

```
plot_ly (
  x = c( 1, 2, 3 ),
  y = c( 5, 6, 7 ),
  type = 'scatter' ,
  mode = 'lines' ,
  fill = 'tozeroy' )
```

Histograms

```
x <- rchisq ( 100, 5, 0 )
  plot_ly (
  x = x ,
  type = 'histogram' )
```

Box Plots

```
plot_ly (
  y = rnorm( 50 ) ,
  type = 'box' ) %>%

add_trace( y = rnorm( 50, 1 ))
```

2D Histogram

```
plot_ly (
  x = rnorm( 1000, sd = 10 ) ,
  y = rnorm( 1000, sd = 5 ) ,
  type = 'histogram2d' )
```

3D Surface Plots

```
# Using a dataframe:
plot_ly (
  type = 'surface' ,
  z = ~volcano )
```

3D Line Plots

```
plot_ly (
  type = 'scatter3d' ,
  x = c( 9, 8, 5, 1 ) ,
  y = c( 1, 2, 4, 8 ) ,
  z = c( 11, 8, 15, 3 ) ,
  mode = 'lines' )
```

3D Scatter Plots

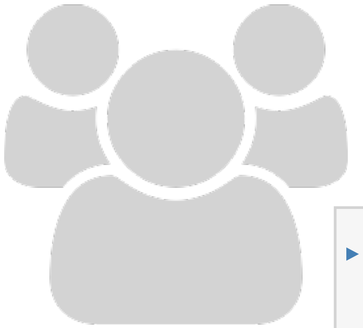
```
plot_ly (
  type = 'scatter3d' ,
  x = c( 9, 8, 5, 1 ) ,
  y = c( 1, 2, 4, 8 ) ,
  z = c( 11, 8, 15, 3 ) ,
  mode = 'markers' )
```

plotly

in an app

DEMO

Go to old_faithful.R



EXERCISE

- Go to movies_20.R
  - Edit the UI and Server functions so that scatter plot uses plotly
  - Create a useful tooltip

5m 00s

SOLUTION

- Check your app against movies_21.R
- Add `library(plotly)`
  - Change `plotOuptut` to `plotlyOutput`
    - Change `renderPlot` to `renderPlotly`
    - Wrap the plot in `ggplotly()`
      - Place tooltip as a paste function in `aes()` and set `tooltip = "text"`
      - Or set `tooltip = c("x", “y")`

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HOMEWORK

Project 1