Shiny for Creating Baseball Visualizations

Jim Albert
Emeritus Professor
Bowling Green State University

SLAM Sport Analytics Summer Academy
June 7, 2021

Outline

- Introduce Shiny apps
- Focus on several baseball applications (Pitch Locations and Brushing Batting Averages)
- Provide R code for creating these apps on my Github site
- Show several live Shiny apps
- Suggest Shiny baseball apps that you can do on your own

Communicating with Data

- Want to gain an understanding "how sports organizations analyze, interpret, and communicate in sport"
- In my experience, students can have difficulties in communication of results
- One way to communicate is to develop a web dashboard that illustrates your work.

What is Shiny?

- R package that facilitates the building of interactive web apps from R
- Can host standalone apps on a webpage
- Can enhance the Shiny app with html and JavaScript script

Process of Building a Shiny App

- Get an idea for what you want to produce
- Write a R function with specific inputs and outputs
- Convert this to a Shiny app
- Easy to borrow code from other Shiny apps that are posted

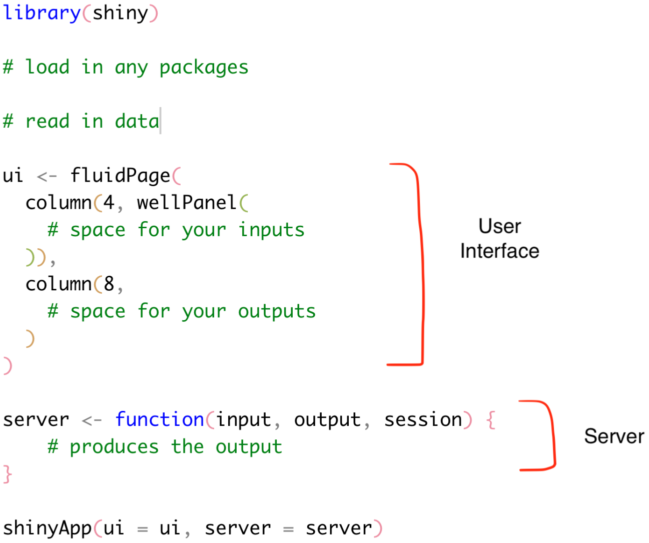
Getting Started with Shiny

- Load the shiny package
- Write a R script `app.r`
- One part of script describes the layout (inputs and outs)
- Second part of script reads the inputs and executes the output
- Third part of script makes the Shiny app

Script app.R

- Function ui() describes the user interface (layout of inputs and outputs)
- Function server() does the work
- Function shinyApp() converts code to a Shiny app

app.R - Basic Shiny Template

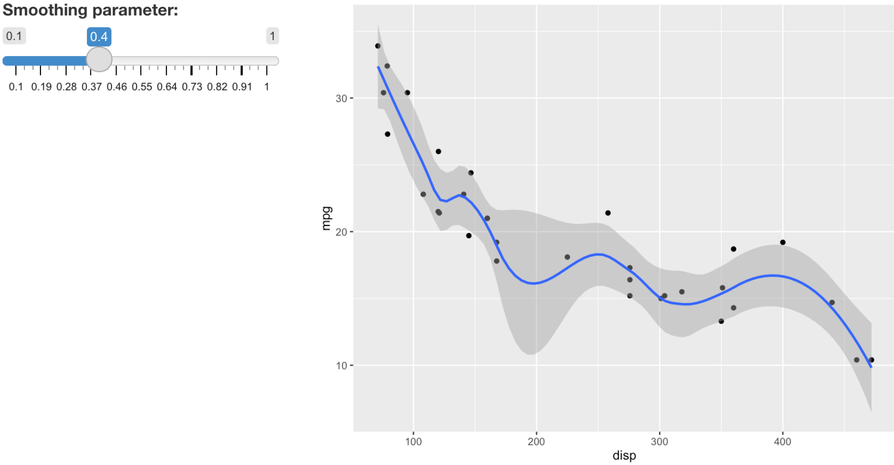


```r
library(shiny)

# load in any packages

# read in data

ui <- fluidPage(
  column(4, wellPanel(
    # space for your inputs
  )),
  column(8,
    # space for your outputs
  )
)

server <- function(input, output, session) {
    # produces the output
}

shinyApp(ui = ui, server = server)
```

Basic Example: Smoothing a Scatterplot

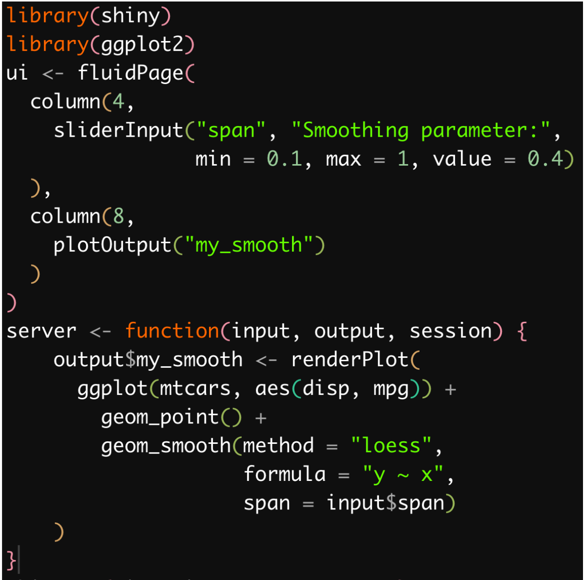
- Interested in showing a scatterplot and the smoothing curve
- Smoothness of curve depends on argument `span`
- Want to show how smooth depends on `span`

Shiny Smoothing Scatterplot



Smoothing parameter: 0.4

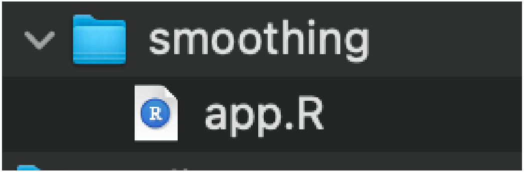
Shiny Smoothing Code



```
library(shiny)
library(ggplot2)
ui <- fluidPage(
  column(4,
    sliderInput("span", "Smoothing parameter:",
                min = 0.1, max = 1, value = 0.4)
  ),
  column(8,
    plotOutput("my_smooth")
  )
)
server <- function(input, output, session) {
    output$my_smooth <- renderPlot(
      ggplot(mtcars, aes(disp, mpg)) +
        geom_point() +
        geom_smooth(method = "loess",
                    formula = "y ~ x",
                    span = input$span)
    )
}
```

To Run Shiny App 1

Put app.R file in separate folder

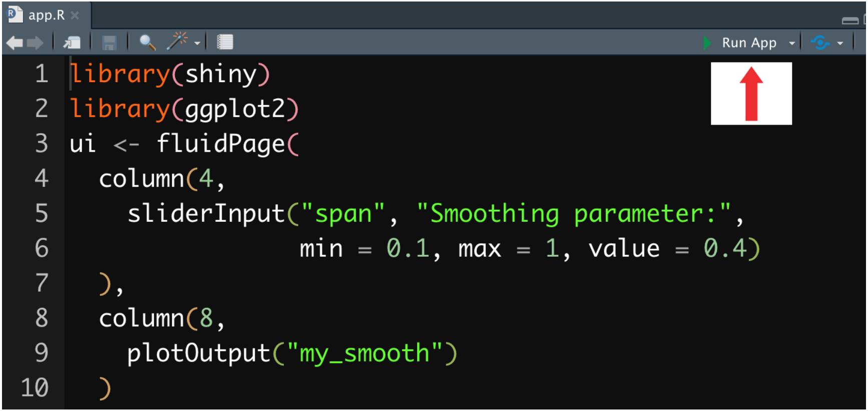


smoothing

app.R

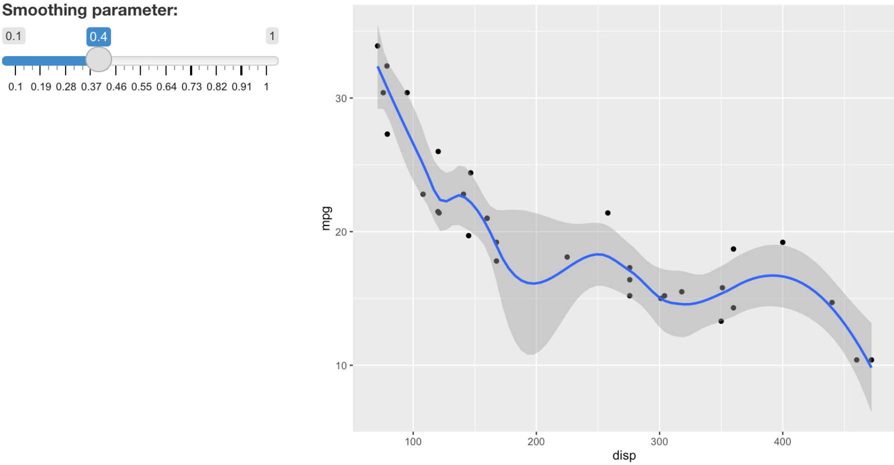
To Run Shiny App 2

Open file in RStudio and push "Run App" button



```r
library(shiny)
library(ggplot2)
ui <- fluidPage(
  column(4,
    sliderInput("span", "Smoothing parameter:",
                min = 0.1, max = 1, value = 0.4)
  ),
  column(8,
    plotOutput("my_smooth")
  )
```

Shiny Output

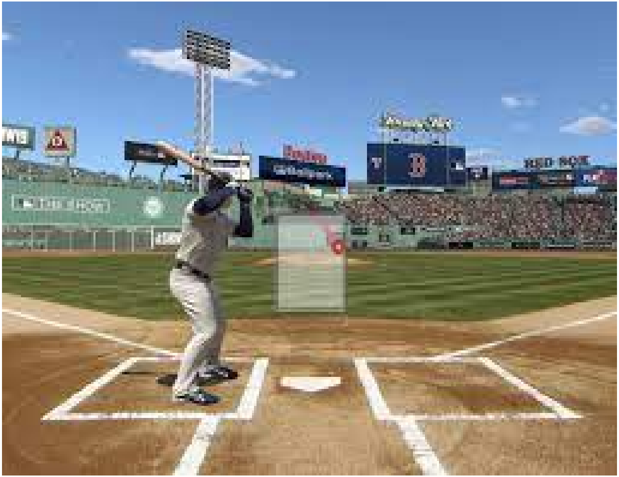


Smoothing parameter: 0.4

Two Baseball Applications

1. Pitch locations by pitch type and count
2. Brushing batting averages over the zone

Watching a MLB Game on Your Device: Pitch Locations



Shiny Pitch Location App

- How does pitch location vary by pitch type and count?
- Want to display pitch locations over zone
- Inputs:
  - specific pitcher
  - specific pitch types
  - specific counts

Shiny Pitch Location App

- Have 2019 Statcast data stored on my Github site
- Information on 732,473 pitches
- Relevant variables
  - pitcher id
  - pitch location (pitch_x, pitch_z)
  - current balls and strikes
  - pitch type

Focus on Aaron Nola (Phillies' Ace)

- Two of his primary pitches are the four-seam fastball and the knuckle curve
- Explore pitch locations of these pitches over 0-2, 1-1, 2-0 counts
- Believe that location depends whether it is pitcher's count or a hitter's count

Write a Function to Perform Task

`construct_graph()`

- input data, pitcher id, pitch types, count
- outputs a ggplot2 display with facets for pitch type and count
- want to turn this function into a Shiny app

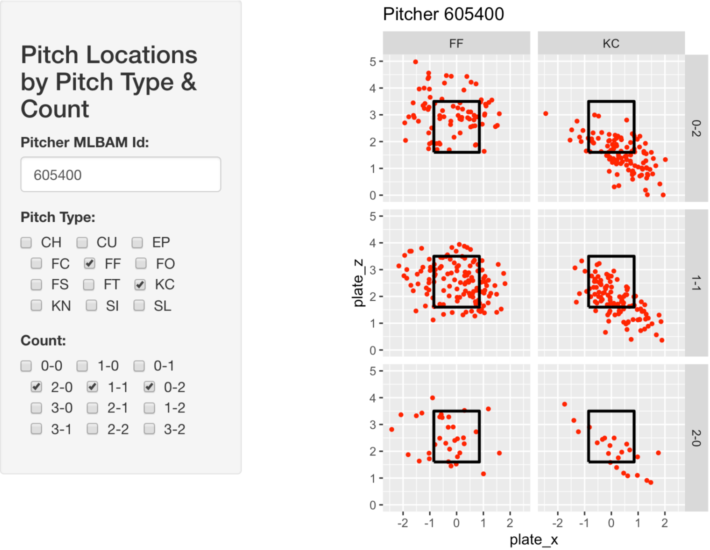
Shiny Input Functions

- Use `textInput()` to enter in the pitcher id
- Use `checkboxGroupInput()` to enter in one or more pitch types
- Use `checkboxGroupInput()` to enter in one or more counts

Shiny Output Functions

- plotOutput() in user interface is paired with renderPlot() in server function
- tableOutput() in user interface is paired with renderTable() in server function

Shiny Pitch Location App - Aaron Nola



Pitch Locations by Pitch Type & Count

Pitcher MLBAM Id:

605400

Pitch Type:

□ CH □ CU □ EP
□ FC ☑ FF □ FO
□ FS □ FT ☑ KC
□ KN □ SI □ SL

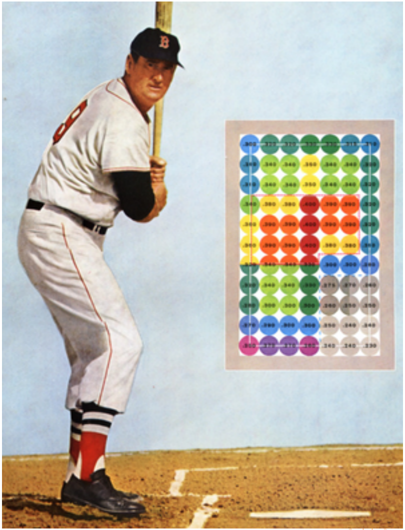
Count:

□ 0-0 □ 1-0 □ 0-1
☑ 2-0 ☑ 1-1 ☑ 0-2
□ 3-0 □ 2-1 □ 1-2
□ 3-1 □ 2-2 □ 3-2

Inspiration for Brushing BA App

- Famous book: “The Science of Hitting” by John Underwood and Ted Williams
- Includes illustration showing Williams’ batting average over different regions about the zone
- Want to use Shiny to do something similar

Ted Williams AVG by Location



.300	.320	.320	.330	.330	.315	.310
.310	.340	.340	.350	.340	.340	.320
.310	.340	.340	.350	.340	.340	.320
.340	.380	.380	.400	.390	.390	.320
.360	.390	.390	.400	.390	.380	.320
.360	.390	.390	.400	.380	.380	.310
.330	.340	.340	.330	.300	.300	.260
.300	.340	.340	.300	.275	.270	.260
.280	.300	.300	.300	.260	.250	.250
.270	.280	.300	.300	.250	.240	.240
.250	.270	.270	.260	.240	.240	.230

Why is this Useful?

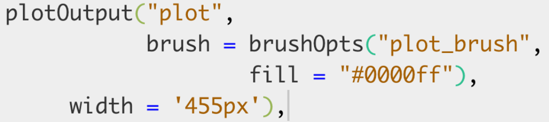
- Every batter likes to see pitches in specific locations
- Each batter has areas of the zone where he is "hot" or "cold"
- Teams (especially the opposing pitchers) want to know this information

Shiny Inputs and Outputs

- One input – name of player of interest
- First output– the graph of pitch locations
- Second output – a table showing the BA over the brushed region

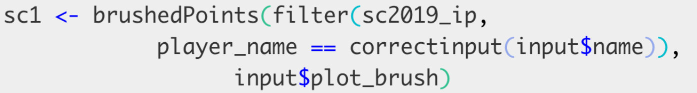
To Enable Shiny Brushing

In user interface, add brush argument to plotOutput() function:



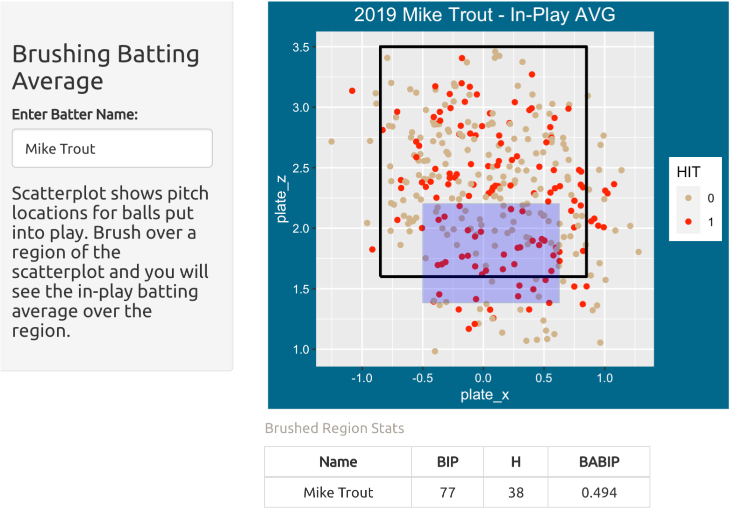
```
plotOutput("plot",
           brush = brushOpts("plot_brush",
                   fill = "#0000ff"),
     width = '455px'),
```

In server (table output) use brushedPoints() function:



```
sc1 <- brushedPoints(filter(sc2019_ip,
            player_name == correctinput(input$name)),
                  input$plot_brush)
```

Shiny Brushing App - 2019 Mike Trout



Brushing Batting Average

Enter Batter Name:

Mike Trout

Scatterplot shows pitch locations for balls put into play. Brush over a region of the scatterplot and you will see the in-play batting average over the region.

Brushed Region Stats

Name	BIP	H	BABIP
Mike Trout	77	38	0.494

Sharing Shiny Apps

- Share the Shiny code (the app.R file, data and functions)
- Put the Shiny apps functions in a R package
- Host the Shiny apps on a server such as `Shinyapps.io`

ShinyBaseball Package

- Collect many of my Shiny apps that explore baseball data
- Once installed and loaded, easy to run the apps using functions
- To run the Brushing app, type

```
BrushingZone()
```

Functions in R Package ShinyBaseball

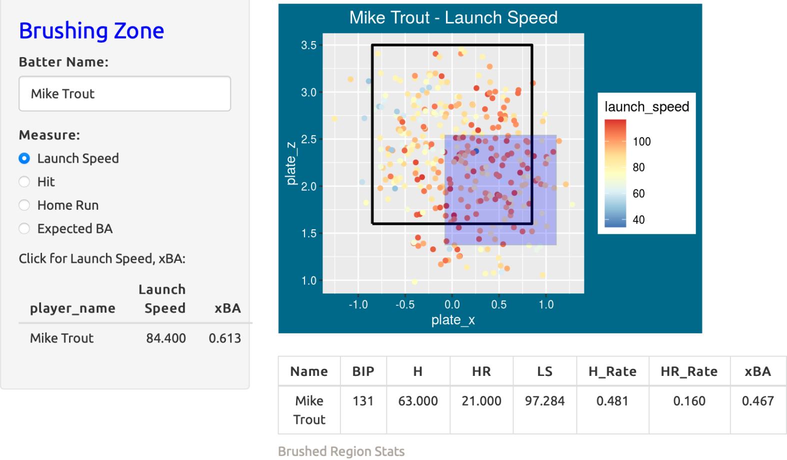
- BatterFourSeam() - Illustrates Four-Seamer Rates Over Zone for a Batter
- BrushingZone() - Brushing Zone Measurements
- PitchOutcome() - Illustrates Pitch Outcomes
- PredictingBatting Rates() - Illustrates Predicting Batting Rates
- RadialChart() - Radial Chart for a Pitcher
- SprayChart() - Locations of Balls in Play

Put Your Shiny App on the Web

- Can use one's own server or RStudio's hosting service
- Shinyapps.io
- Free and paid options available
- I'll show several of my live Shiny apps

bayesball.shinyapps.io/BrushingZone

Fancier version of brushing app.



Brushing Zone

Batter Name:

Mike Trout

Measure:

● Launch Speed

○ Hit

○ Home Run

○ Expected BA

Click for Launch Speed, xBA:

player_name	Launch Speed	xBA
Mike Trout	84.400	0.613

Name	BIP	H	HR	LS	H_Rate	HR_Rate	xBA
Mike Trout	131	63.000	21.000	97.284	0.481	0.160	0.467

Brushed Region Stats

Home Run Story

- MLB has seen a dramatic impact in home run hitting
- Batters have changed approach?
- Does the ball have an impact?
- Weather, ballpark effects?

Home Run Story

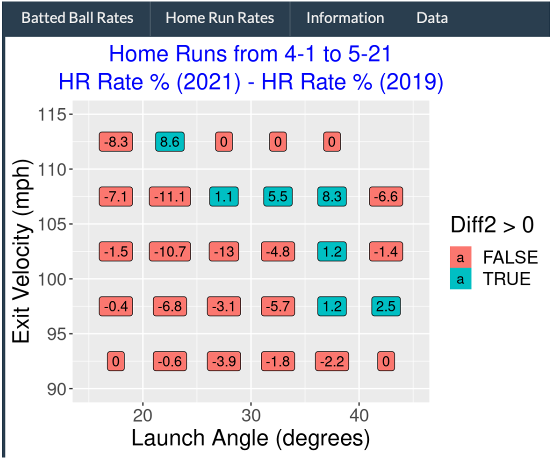
- To hit a home run, need to hit the ball hard (high exit velocity)
- Also need a suitable launch angle (around 30 degrees)
- Given exit velocity and launch angle measurements, what is the chance of home run
- This HR probability has changed over seasons

Home Run App

- Select a time interval and two seasons to compare
- Categorize balls in play by launch angle and exit velocity
- Compare home run rates in two seasons
- Takeaway: the 2021 ball is different from the 2019 ball

bayesball.shinyapps.io/HomeRunsCompare

Compares home run rates for two seasons.



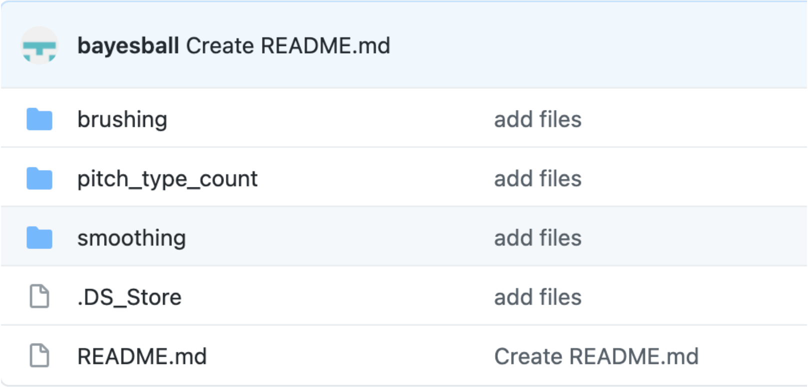
How to Learn Shiny?

- Look at the Shiny tutorial material at `https://shiny.rstudio.com/`
- Look at Shiny demos
- Material for this talk can be found at `https://github.com/bayesball/LearnShiny`
- Start with a simple template and add features incrementally

Your Turn

- I have posted several Shiny apps on my Github site
- Try them out
- I will suggest some modifications for you to try

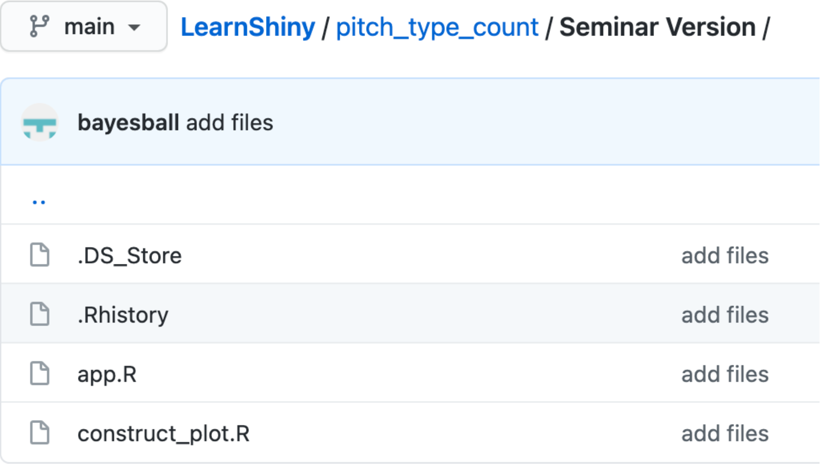
github.com/bayesball/LearnShiny



bayesball Create README.md

brushing	add files
pitch_type_count	add files
smoothing	add files
.DS_Store	add files
README.md	Create README.md

The Pitch Type Count App



main

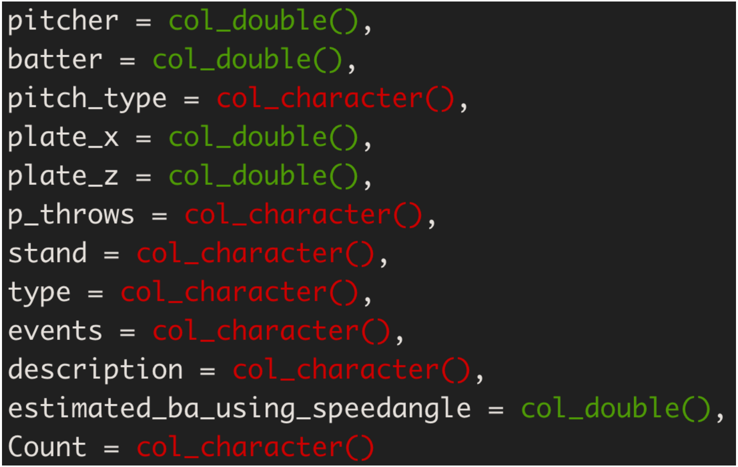
LearnShiny / pitch_type_count / Seminar Version /

bayesball add files

..

.DS_Store	add files
.Rhistory	add files
app.R	add files
construct_plot.R	add files

Dataset Variables

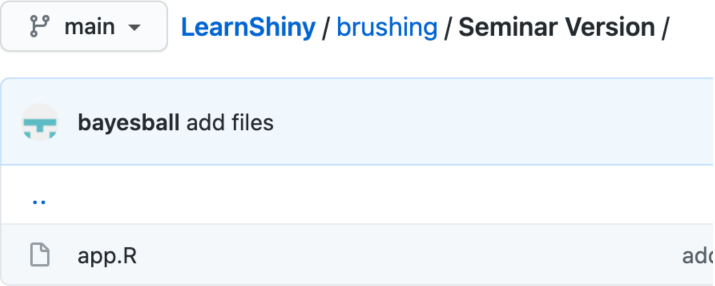


```
pitcher = col_double(),
batter = col_double(),
pitch_type = col_character(),
plate_x = col_double(),
plate_z = col_double(),
p_throws = col_character(),
stand = col_character(),
type = col_character(),
events = col_character(),
description = col_character(),
estimated_ba_using_speedangle = col_double(),
Count = col_character()
```

Things to Try

- Focus on a specific pitcher
- Focus on how a pitcher throws to Right and Left handed batters (variable stand)
- Show pitch locations of a specific pitch type against R and L
- Use facets to show pitch locations by pitch type and batter side

The Brushing App



main

LearnShiny / brushing / Seminar Version /

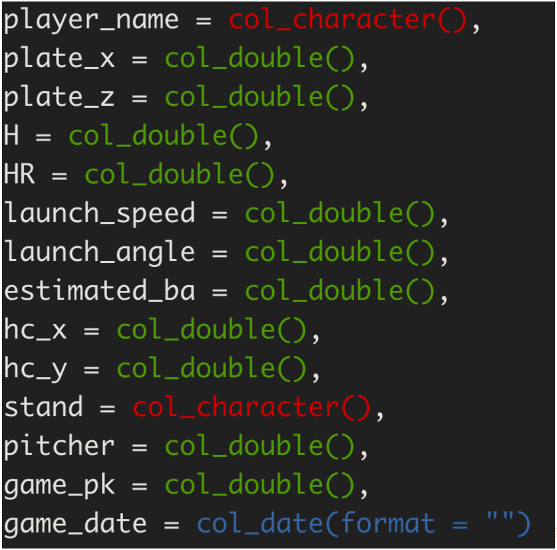
bayesball add files

..

app.R

add

Dataset Variables



```
player_name = col_character(),
plate_x = col_double(),
plate_z = col_double(),
H = col_double(),
HR = col_double(),
launch_speed = col_double(),
launch_angle = col_double(),
estimated_ba = col_double(),
hc_x = col_double(),
hc_y = col_double(),
stand = col_character(),
pitcher = col_double(),
game_pk = col_double(),
game_date = col_date(format = "")
```

Things to Try

- Focus on a specific hitter
- Instead of brushing hits (variable H) ...
- Display and brush home runs
- Display expected batting average and brush these values

To Get Further Ideas

- Visit the Baseball Savant website (home of Statcast data)
- Look at the various visualizations
- Try to replicate or improve what they show on this site
- I wrote a Shiny app to produce a "Radial Chart"

To Get Further Ideas

- I contribute to the blog “Exploring Baseball Data with R” https://baseballwithr.wordpress.com/
- All of my R code is available on Github https://github.com/bayesball

Questions?

Ask me here or email me at albert@bgsu.edu