Getting Started with R Shiny: Build and Deploy Interactive Web Apps

Coffee, Cookie and Coding (C^3) Workshop supported by the Public Health Data Science and Data Equity team

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Feb 17th, 2025

Yale SCHOOL OF PUBLIC HEALTH
Data Science and Data Equity

Howard Baik, M.S.

- Worked 1.5 years as a Software Development Engineer on R packages and Shiny applications.
- Received a Masters in Biostatistics from the University of Washington in 2023.

Today's Learning Objectives

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01 Understand the basic structure of a Shiny app, including UI (User Interface) and server components.

02 Learn to use reactive elements to make your app dynamic and interactive.

03 Create a simple interactive application using a data example.

04 Learn how to deploy Shiny apps using a self-service platform like shinyapps.io

Our Choice Resources

- Mastering Shiny: https://mastering-shiny.org/
- Shiny Basics: https://shiny.posit.co/r/getstarted/shiny-basics/lesson1/
- Shiny Gallery: https://shiny.posit.co/r/gallery/

Introduction to Shiny in R

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Shiny for R

Shiny is an R package that makes it easy to build interactive web apps straight from R. You can also extend your Shiny apps with CSS, HTML, and JavaScript.

Example of a Shiny App

SAMBA-EHR

SAMBA-EHR: Sampling And Misclassification Bias Analysis in Genome and Phenome-wide Association Studies using Electronic Health Records

This tool allows researchers to explore the impact of disease-related sampling and phenotype misclassification on the bias in association estimates from GWAS/PheWAS studies based on large-scale observational databases such as electronic health records.
Click here for example vignette

Model Specification | Bias of Simple Analysis | Sensitivity Analysis for "True" Effect of G

Plotted Quantity:

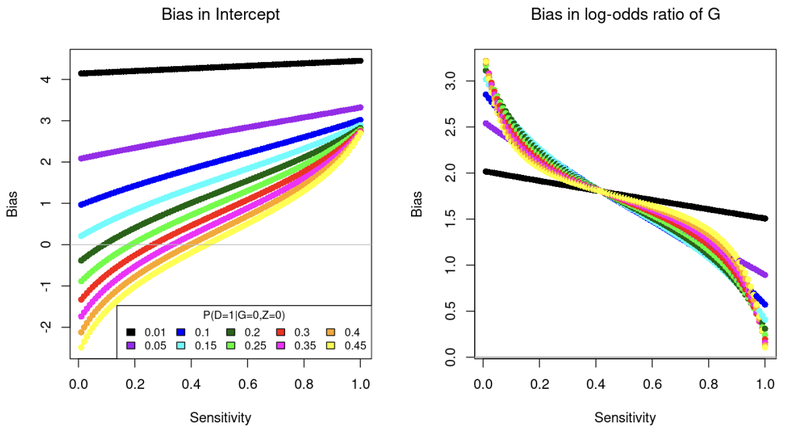
Bias of Simple Analysis Estimate

True Log-Odds Ratio: -1.8 (-3 to 3)

Sampling Ratio: 8.1 (0 to 10)

1-Specificity: 0.42 (0 to 0.5)

Genetic Information:

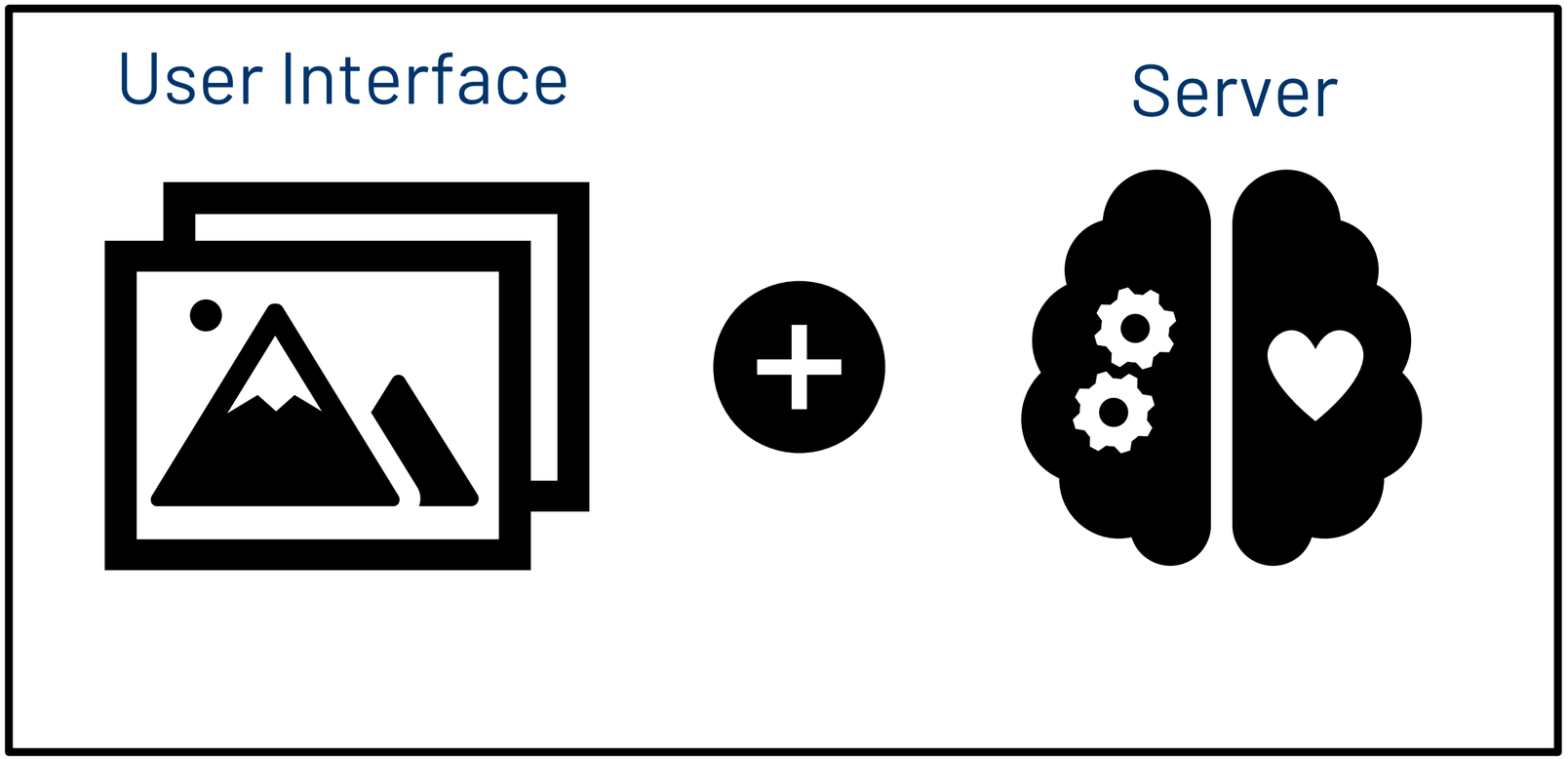


These plots provide expressions for the bias in estimating the effect of G and the intercept when we fit a simple logistic regression model for D*|G,Z,S=1 in our sampled dataset. We assume that the data follow the proposed model.

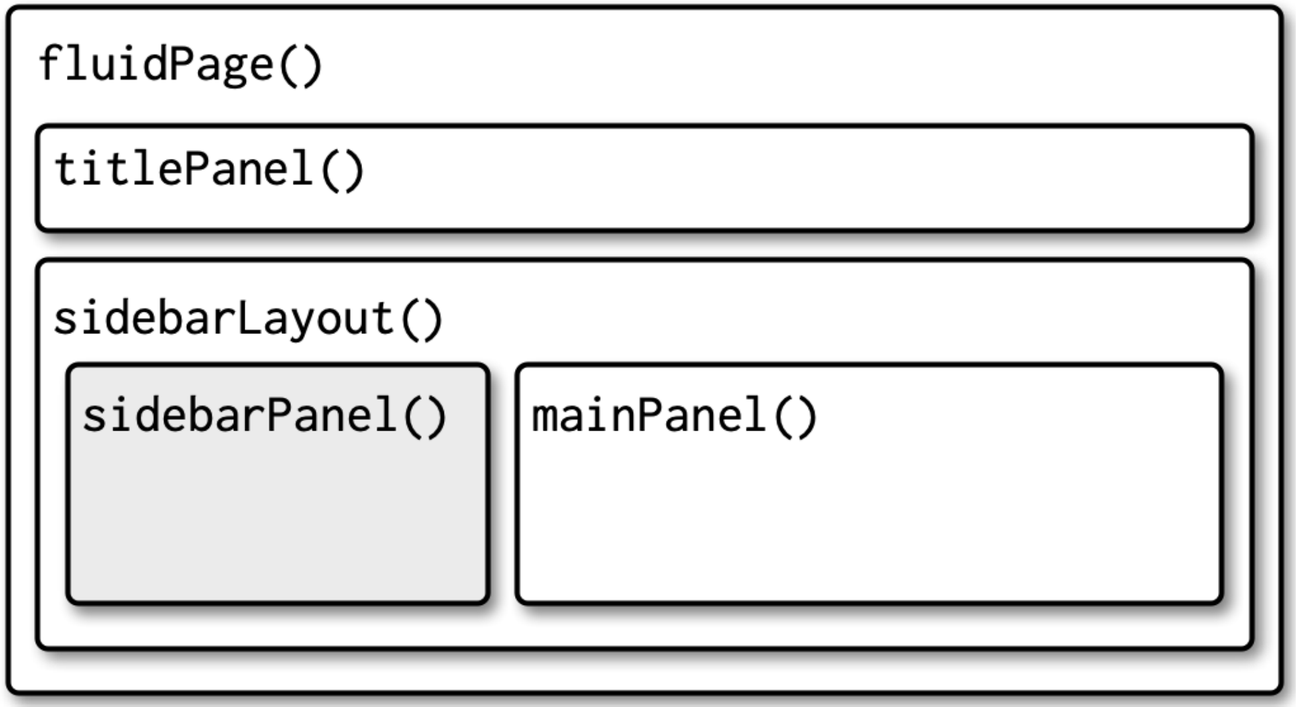
NOTE: If help information does not appear when you hover over the question marks, try reloading the page.

Developed by Dr. Lauren J Beesley, Department of Biostatistics, University of Michigan. Contact: lbeesley@umich.edu

Structure of a Shiny App

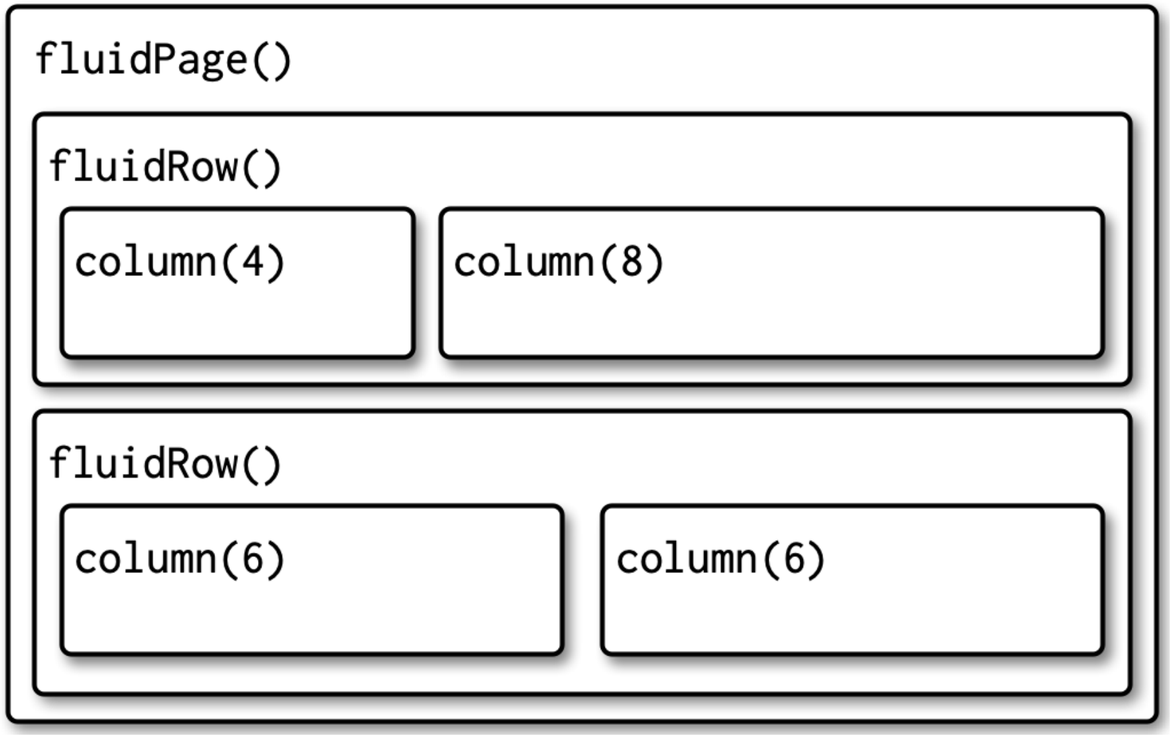


Sidebar Layout




```
fluidPage(
  titlePanel(),
  sidebarLayout(
    sidebarPanel(),
    mainPanel()
  )
)
```

Multi-row Layout




```
fluidPage(
  fluidRow(
    column(4, ),
    column(8, )
  ),
  fluidRow(
    column(6, ),
    column(6, )
  )
)
```

Other Layouts

- Tabsets: Use tabsetPanel()
- Navbars and navlists: Use navlistPanel() and navbarPage()
- Dashboards: shinydashboard and Quarto Dashboards

UI functions are just HTML

Shiny's interface is just a web page, and this can be seen by the fact that UI functions are just R functions that generate HTML.

We can run any of the following in our console and see the HTML output generated:

- `fluidPage()`
- `sidebarLayout(sidebarPanel(),mainPanel())`

Shiny Inputs

- Functions like `selectInput()`, `textInput()`, and `sliderInput()` insert inputs controls into your UI.
- All input functions have the same first argument: **inputID**.
- **inputID** is the identifier used to connect the front end with the back end. If UI has input with **inputID**, "name", the server will access it with **input$name.**

Shiny Inputs

Examples:

```
selectInput("state",
            "What's your favorite state?", state.name)
numericInput("num", "Number one",
             value = 0, min = 0, max = 100)
textInput("name", "What's your name?")
```

Shiny Inputs

Gallery with Shiny Input Widgets:

https://shiny.posit.co/r/gallery/widgets/widget-gallery/

Shiny Outputs

Each **output** function on the front end is coupled with a **render** function in the back end.

Three main types of output, corresponding to the three things you usually include in a report:

1. Text
2. Tables
3. Plots.

Shiny Outputs: Text

Regular text with **textOutput()** and **renderText()**

```
ui <- fluidPage(
  textOutput("text")
)
server <- function(input, output, session) {
  output$text <- renderText({
    "Hello friend!"
  })
}
```

Shiny Outputs: Tables

tableOutput() and **renderTable()** render a static table of data, showing all the data at once.

```
ui <- fluidPage(tableOutput("static"))

server <- function(input, output, session) {

    output$static <- renderTable(head(mtcars))

}
```

Shiny Outputs: Plots

You can display any type of R graphic (base, ggplot2, or otherwise) with **plotOutput()** and **renderPlot()**:

```
ui <- fluidPage(
 plotOutput("plot”)
)
server <- function(input, output, session) {
 output$plot <- renderPlot(plot(1:5))
}
```

Reactivity

Introduction to Reactivity

Reactive programming is what connects your inputs to your outputs.

Inputs and outputs are defined by the elements in our UI.

Reactivity

UI Function

```
selectInput(“state”,  “Choose a State”,

              choices = c(“Washington”,
                          “Pennsylvania”,
                          “Connecticut”)

             )

plotOutput("plot”)
```

Reactivity

Server Function

```
output$plot <-  renderPlot({

    df  |>

    filter(Province_State == input$state)|>

    ggplot(aes(x = Date,

               y = Percentage_at_least_one_dose)) +

    geom_line()

})
```

Reactivity

UI Function

```
selectInput(“state”,
            “Choose a State”,
          choices = c(“Washington”,
                      “Pennsylvania”,
                       “Connecticut”)
)
plotOutput("plot”)
```

Server Function

```
output$plot <-  renderPlot({
     df  |>
     filter(Province_State == input$state)|>
     ggplot(aes(x = Date,
                      y = Percentage_at_least_one_dose)
            ) +
     geom_line()
})
```

Worked Through Example:

https://github.com/ysph-dsde/Getting-Started-with-R-Shiny-Workshop

Dataset Information

The dataset contains vaccination data of U.S. States.

Data Dictionary:

- **Date**: Date collection date
- **Province_State**: The name of the state or province.
- **People_at_least_one_dose**: Cumulative number of people who received at least one vaccine dose. When the person receives a prescribed second dose it is not counted twice.
- **People_fully_vaccinated**: Cumulative number of people who received a complete primary series. This means having received one dose of a single-dose vaccine or two doses on different days (regardless of time interval) of either a mRNA or a protein-based series.

Deploy Shiny apps using shinyapps.io

1. Go to shinyapps.io
2. Sign up or log in using email and password
3. Once logged in, navigate to **Account > Tokens**.
4. Click **Add Token > Copy to clipboard.**
5. Install the rsconnect R package (`install.packages("rsconnect")`)
6. In your R console, authenticate your shinyapps.io account by pasting the token details you copied:

```
rsconnect::setAccountInfo(name = 'your_account_name',
                          token = 'your_token',
                          secret = 'your_secret')
```

7. Deploy the app: `rsconnect::deployApp()`

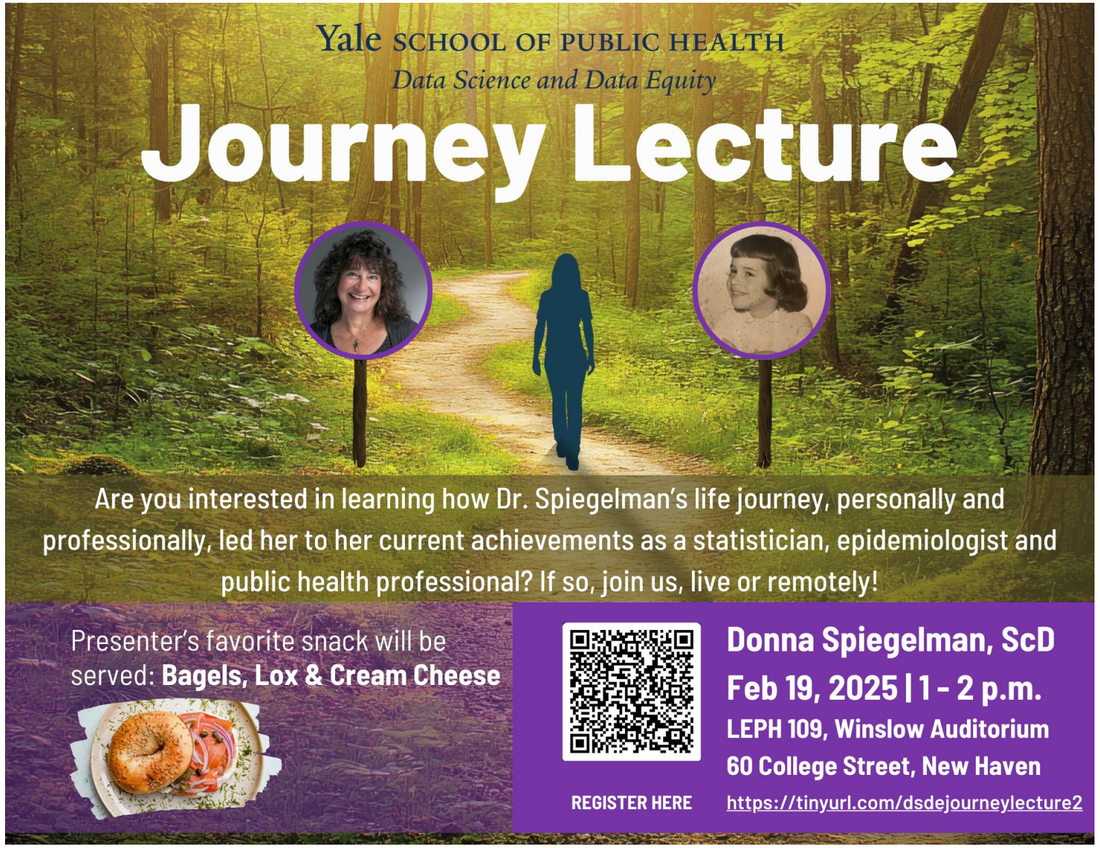
Appendix

References

- GLEON 2021 Workshop – R shiny apps for beginners: https://youtu.be/U3w9ftlyh_E?si=BQ-FJJXzfcCtGle3
- Workshop at Posit Conference 2024 – Introduction to Shiny for R: https://github.com/posit-conf-2024/shiny-r-intro
- Mastering Shiny: https://mastering-shiny.org/index.html

Evaluation

Next DSDE Event



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