Using shiny with flexdashboard

Overview

By adding Shiny to a flexdashboard, you can create dashboards that enable viewers to change underlying parameters and see the results immediately, or that update themselves incrementally as their underlying data changes (see `reactiveFileReader` and `reactivePoll`). This is done by adding `runtime: shiny` to a standard flexdashboard and then adding one or more input controls and/or reactive expressions that dynamically drive the appearance of the components within the dashboard.

Using Shiny with flexdashboard turns a static R Markdown report into an Interactive Document. It's important to note that interactive documents need to be deployed to a Shiny Server to be shared broadly (whereas static R Markdown documents are standalone web pages that can be attached to emails or served from any standard web server).

Note that the shinydashboard package provides another way to create dashboards with Shiny.

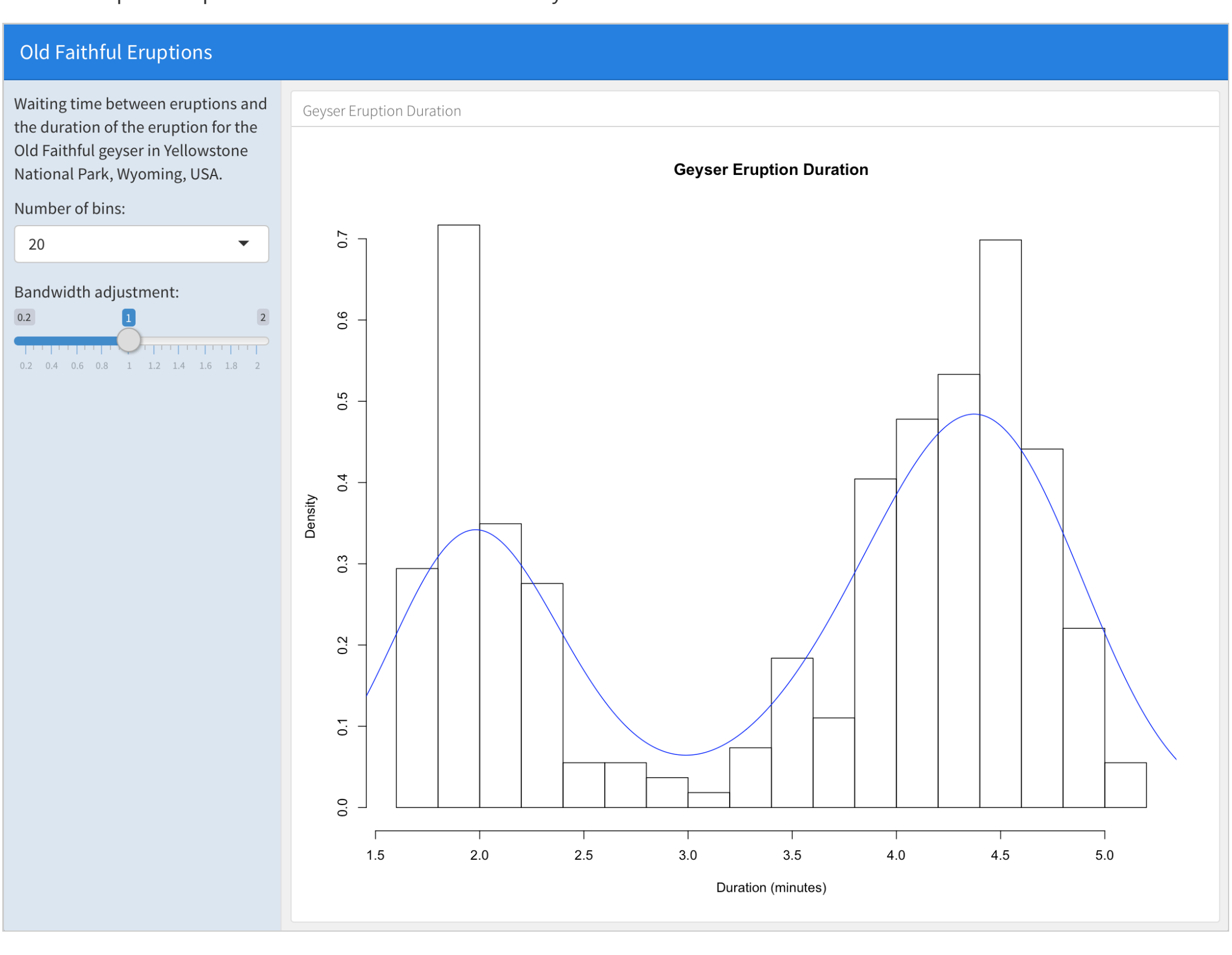
Getting Started

The steps required to add Shiny components to a flexdashboard are as follows:

1. Add `runtime: shiny` to the options declared at the top of the document (YAML front matter).
2. Add the `{.sidebar}` attribute to the first column of the dashboard to make it a host for Shiny input controls (note this step isn't strictly required, but many Shiny based dashboards will want to do this).
3. Add Shiny inputs and outputs as appropriate.
4. When including plots, be sure to wrap them in a call to renderPlot. This is important not only for dynamically responding to changes but also to ensure that they are automatically re-sized when their container changes.

Simple Example

Here's a simple example of a flexdashboard that uses Shiny:



Source Code

````
---
title: "Old Faithful Eruptions"
output: flexdashboard::flex_dashboard
runtime: shiny
---

```{r global, include=FALSE}
# load data in 'global' chunk so it can be shared by all users of the dashboard
library(datasets)
data(faithful)
```

Column {.sidebar}
-----------------------------------------------------------------------

Waiting time between eruptions and the duration of the eruption for the
Old Faithful geyser in Yellowstone National Park, Wyoming, USA.

```{r}
selectInput("n_breaks", label = "Number of bins:",
            choices = c(10, 20, 35, 50), selected = 20)

sliderInput("bw_adjust", label = "Bandwidth adjustment:",
            min = 0.2, max = 2, value = 1, step = 0.2)
```

Column
-----------------------------------------------------------------------

### Geyser Eruption Duration

```{r}
renderPlot({
  hist(faithful$eruptions, probability = TRUE, breaks = as.numeric(input$n_breaks),
       xlab = "Duration (minutes)", main = "Geyser Eruption Duration")

  dens <- density(faithful$eruptions, adjust = input$bw_adjust)
  lines(dens, col = "blue")
})
```

````

The first column includes the `{.sidebar}` attribute and two Shiny input controls; the second column includes the Shiny code required to render the chart based on the inputs.

One important thing to note about this example is the chunk labeled `global` at the top of the document. The `global` chunk has special behavior within flexdashboard: it is executed only once within the global environment so that it's results (e.g. data frames read from disk) can be accessed by all users of a multi-user flexdashboard. Loading your data within a `global` chunk will result in substantially better startup performance for your users so is highly recommended.

Using Shiny

Loading Data

As described above, you should perform any expensive loading of data within the `global` chunk, for example:

````
```{r global, include=FALSE}
# load data in 'global' chunk so it can be shared by all users of the dashboard
data <- readr::read_csv("data.csv")
```
````

Note that special handling of the `global` chunk is a recently introduced feature of the **rmarkdown** package (v1.1 or later) so you should be sure to install the latest version of rmarkdown from CRAN before using it:

```
install.packages("rmarkdown", type = "source")
```

Inputs & Outputs

When you use Shiny within a flexdashboard you'll be making use of both input elements (e.g. sliders, checkboxes, etc.) and output elements (plots, tables, etc.). Input elements are typically presented within a sidebar and outputs within flexdashboard content panes (it's also possible to combine inputs and outputs in a single pane, this is described in more detail below).

Here's a simple example of a shiny input and corresponding output:

```
sliderInput("bins", "Number of bins:",
            min = 1, max = 50, value = 30)

renderPlot({
  hist(faithful[, 2], breaks = input$bins)
})
```

The `sliderInput` call makes a slider input named "bins" available. The `renderPlot` function is then able to access the value of the "bins" input via the expression `input$bins`.

As illustrated above, inputs are added by calling an R function (e.g. `sliderInput`). The Shiny package makes available a wide variety of functions for creating inputs, a few of them include:

R Function	Input Type
selectInput	A box with choices to select from
sliderInput	A slider bar
radioButtons	A set of radio buttons
textInput	A field to enter text
numericInput	A field to enter numbers
checkboxInput	A single check box
dateInput	A calendar to aid date selection
dateRangeInput	A pair of calendars for selecting a date range
fileInput	A file upload control wizard

Outputs react to changes in input by running their render code (e.g. the `renderPlot` example above) and displaying updated output. The Shiny package also includes a wide variety of render functions, including:

R Function	Output Type
renderPlot	R graphics output
renderPrint	R printed output
renderTable	Data frame, matrix, other table like structures
renderText	Character vectors

In the sections below we'll cover additional details on how to use Shiny components within a flexdashboard. If you aren't already familiar with Shiny you may also want to consult the Shiny Dev Center, which includes extensive articles, tutorials, and examples to help you learn more about Shiny.

Input Sidebar

You add an input sidebar to a flexdashboard by adding the `{.sidebar}` attribute to a column, which indicates that it should be laid out flush to the left with a default width of 250 pixels and a special background color. Sidebars always appear on the left no matter where they are defined within the flow of the document.

You can alter the default width of the sidebar using the `data-width` attribute, for example:

````
---
title: "Sidebar Width"
output: flexdashboard::flex_dashboard
runtime: shiny
---

Inputs {.sidebar data-width=300}
-----------------------------------------------------------------------

```{r}
# shiny inputs defined here
```

````

Global Sidebar

If you are creating a flexdashboard with Multiple Pages you may want to use a single sidebar that applies across all pages. In this case you should define the sidebar using a level 1 markdown header (the same as is used to define pages).

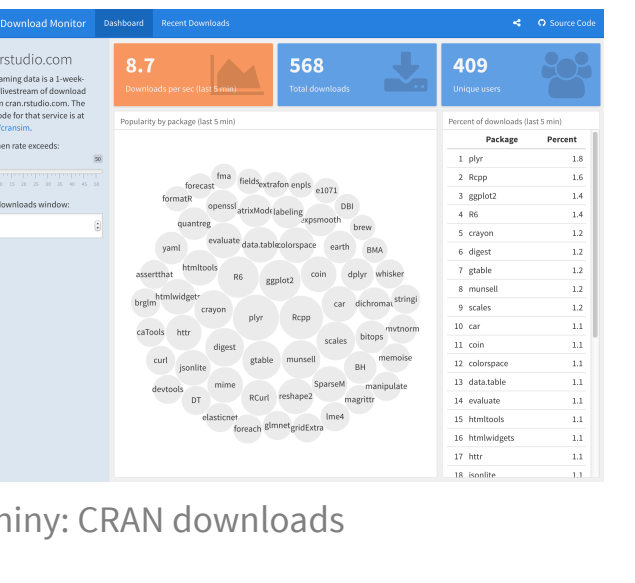
For example, this dashboard includes a global sidebar:

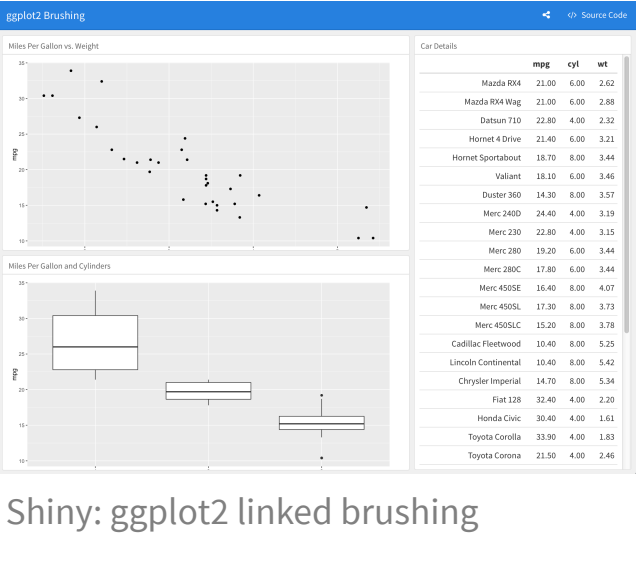
````
---
title: "Sidebar for Multiple Pages"
output: flexdashboard::flex_dashboard
runtime: shiny
---

Sidebar {.sidebar}
=====================================

```{r}
# shiny inputs defined here
```

Page 1
=====================================

### Chart 1

```{r}
```

Page 2
=====================================

### Chart 2

```{r}
```

````

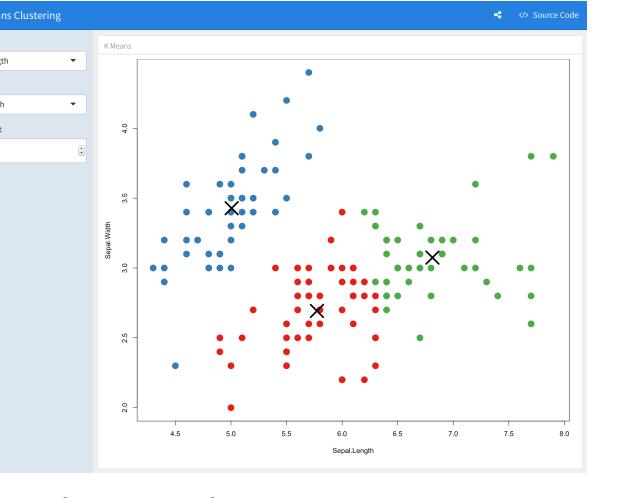
Examples

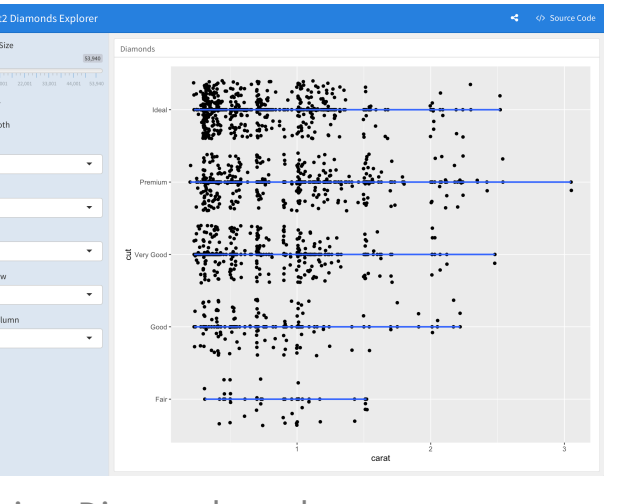
Several examples are available to help you learn more about using Shiny with flexdashboard (each example includes full source code):

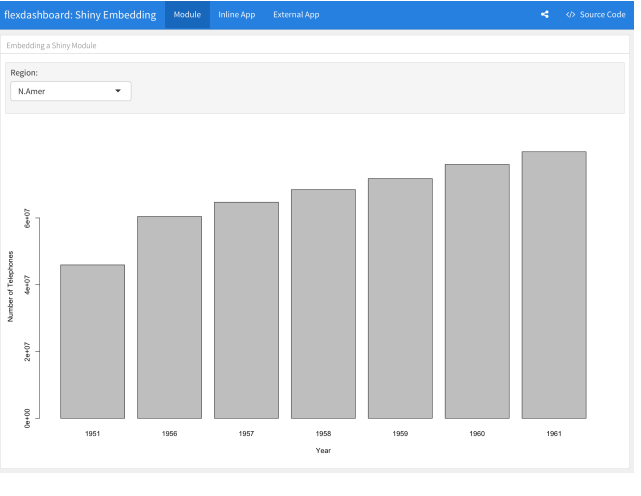

Shiny: biclust example


Shiny: CRAN downloads


Shiny: ggplot2 linked brushing


Shiny: kmeans clustering


Shiny: Diamonds explorer


Shiny: Embedding

Learning More

The following articles are excellent resources for learning more about Shiny and creating interactive documents:

1. The Shiny Dev Center includes extensive articles, tutorials, and examples to help you learn more about Shiny.
2. The Introduction to Interactive Documents article provides a great resources for getting started with Shiny and R Markdown.
3. The R Markdown website includes additional details on the various options for deploying interactive documents.

Advanced

After you've gotten started with using Shiny within flexdashboard and learned more about Shiny development you may want to review these additional topics which described advanced component layout and embedding existing Shiny applications within a flexdashboard.

Component Layout

There are a couple different approaches to laying out Shiny components within a flexdashboard:

1. Place inputs in a sidebar and outputs within their own flexdashboard panel (the strategy illustrated in the example above).
2. Mix inputs and output(s) within a single flexdashboard panel.

The first option is the most straightforward and is highly encouraged if it meets the layout and interactivity requirements of your dashboard. The second option provides for more customized layout but requires the use of Shiny fill layouts.

Fill Layout

When you mix multiple Shiny inputs and/or outputs within a flexdashboard panel it's good practice to have them fill the bounds of their container in the same way that other flexdashboard components like plots and htmlwidgets do. This is possible using the Shiny `fillRow` and `fillCol` layout functions.

For example, here's how you'd use `fillCol` within a code chunk to ensure that a Shiny input and plot output naturally fill their flexdashboard container:

````
```{r}
fillCol(height = 600, flex = c(NA, 1),
  inputPanel(
    selectInput("region", "Region:", choices = colnames(WorldPhones))
  ),
  plotOutput("phonePlot", height = "100%")
)

output$phonePlot <- renderPlot({
  barplot(WorldPhones[,input$region]*1000,
          ylab = "Number of Telephones", xlab = "Year")
})
```
````

If you are new to Shiny then the code above won't make any sense to you. In that case we highly recommend that you use the default layout strategy described above! (i.e. inputs within the sidebar and outputs within their own flexdashboard containers).

For those familiar with Shiny here are further details on how this example works:

1. The container is laid out using the `fillCol` function, which establishes a single column layout with flexible row heights.
2. Flexible height behavior is defined via `flex = c(NA, 1)`. The `NA` applies to the first component (the input panel) and says to not give it flexible height (i.e. allow it to occupy it's natural height). The `1` applies to the second component (the plot) and says that it should have flexible height (i.e. occupy all remaining height in the container).
3. The call to `plotOutput` includes `height = "100%"` to ensure that the plot takes advantage of the height allocated to it by the `fillCol` flexible layout.
4. Finally, note that unlike the simpler layout examples above this examples uses an explicit `plotOutput / renderPlot` pairing rather than just a standalone `renderPlot`. This is so that the plot can be included in a more sophisticated layout scheme (i.e. one more like traditional `ui.R` layout).

You can learn more about flexible layouts in the Shiny Dev Center article on fill layouts as well as the reference documentation for the `fillCol` and `fillRow` functions.

Scrolling Height

By default flexdashboard layouts fill the contents of the browser (`vertical_layout: fill`). Using the techniques described above ensures that your Shiny components will play well within a fill layout, expanding to occupy all available space.

However, when flexdashboards are displayed on mobile phones they automatically switch to a scrolling layout. In this mode Shiny fill layouts are displayed at a height of 500 pixels by default. You should test your dashboards on a mobile phone browser (or using Google Chrome's Device Mode) and if this height isn't ideal you should provide an explicit height for the `fillCol` or `fillRow` as is done in the example above.

Shiny Modules

Shiny Modules enable you to define a piece of Shiny UI and server logic that can be embedded within a larger Shiny application or interactive document. There are a couple of significant benefits to using Shiny Modules in the context of flexdashboard:

1. You can define Shiny Modules within a separate R script. For Shiny components that require a lot of R code this is often preferable to including all the code inline.
2. Shiny Modules can accept parameters, which enable them to be more easily re-used in different contexts.

Here is the "WorldPhones" example from above re-written as a Shiny Module (this code is defined in a standalone R script):

worldPhones.R

```
# Shiny worldPhones module

# UI function
worldPhonesUI <- function(id) {
  ns <- NS(id)
  fillCol(height = 600, flex = c(NA, 1),
    inputPanel(
      selectInput(ns("region"), "Region:", choices = colnames(WorldPhones))
    ),
    plotOutput(ns("phonePlot"), height = "100%")
  )
}

# Server function
worldPhones <- function(input, output, session) {
  output$phonePlot <- renderPlot({
    barplot(WorldPhones[,input$region]*1000,
            ylab = "Number of Telephones", xlab = "Year")
  })
}
```

Here is the code to include the module within a flexdashboard:

````
```{r}
# include the module
source("worldPhones.R")

# call the module
worldPhonesUI("phones")
callModule(worldPhones, "phones")
```
````

You can learn more about creating and using Shiny Modules at the Shiny Dev Center.

Inline Applications

While Shiny applications are often defined in standalone R source files (e.g. ui.R and server.R) it's also possible to define a full application inline using the `shinyApp` function.

You can embed inline Shiny applications within a flexdashboard. For example, the following code chunk defines a simple Shiny application consisting of a select input and a plot:

````
```{r}
shinyApp(
  ui = fillPage(
    fillCol(flex = c(NA, 1),
      inputPanel(
        selectInput("region", "Region:", choices = colnames(WorldPhones))
      ),
      plotOutput("phonePlot", height = "100%")
    )
  ),
  server = function(input, output) {
    output$phonePlot <- renderPlot({
      barplot(WorldPhones[,input$region]*1000,
              ylab = "Number of Telephones", xlab = "Year")
    })
  },
  options = list(height = 600)
)
```
````

You'll note that this example uses the same "WorldPhones" code which was the basis of the previous embedding examples. However, in this case the code is wrapped in a top level `fillPage`. Also note that the `shinyApp` call includes an explicit `options = list(height = 600)` for use in scrolling layouts.

When embedding Shiny components using an inline application definition an `<iframe>` is created to host the application. In contrast, when using Shiny Modules the components are included inline on the page (inheriting the containing page's CSS).

External Applications

It's also possible to include a Shiny application defined in an external directory within a flexdashboard. For example, the following code chunk includes one of the Shiny example applications:

````
```{r}
shinyAppDir(
  system.file("examples/06_tabsets", package="shiny"),
  options = list(height=850)
)
```
````

Note that in this example we override the default height of 500 pixels via `options = list(height=850)`. This is because this application uses a sidebar which on mobile layouts will appear on top of the plot output rather than to the left, which necessitates that more height be available for it's display.

Including an external Shiny application is a good way to re-use an existing application within a flexdashboard. If however your main goal is to keep the source code for a set of Shiny components separate from the main flexdashboard Rmd then Shiny Modules are a preferable way to achieve this, as they include their UI inline within the page rather than within an `<iframe>`.