Telling Stories With Data: Comparing Program Outcomes with ggplot2
Andy Grogan-Kaylor
2019-12-10

Contents

1 Background 2
2 Load the Simulated Social Service Agency Data 2
3 Load the Libraries 2
4 First Approach (x is program; y is mental health) 3
5 Add Geometries That Show The Average 3
5.1 Bar Chart 3
5.2 Horizontal Bar Chart 3
5.3 Point Chart 4
5.4 "Lollipop" Chart 4
5.5 Line Chart 4
6 Add Geometries That Show the Distribution 4
6.1 Boxplot 4
6.2 Violin Plot 5
6.3 Points 5
6.4 Jittered Points 5
6.5 Beeswarm Plot 5
7 Second Approach (x is mental health; facet wrap on program) 5
8 Add Geometries 5
8.1 Histogram 6
8.2 Density 6
9 Third Approach (x is mental health; transparent geometries) 6
10 Add Geometries 6
10.1 Histogram 6
10.2 Density 6
1 Background

ggplot2 is a powerful graphing library that can make beautiful graphs. gggplot2 can also help us to understand ideas of an underlying "grammar of graphics".

However, ggplot can be difficult to learn. I am thinking that one way to better understand gggplot2 might be to see how this graphing library could be applied to a concrete example of comparing program outcomes.

In this example, program is a factor and outcome is numeric.

2 Load the Simulated Social Service Agency Data

load("social_service_agency.RData") # simulated data

Table 1: Table continues below

<table>
<thead>
<tr>
<th>ID</th>
<th>age</th>
<th>gender</th>
<th>program</th>
<th>mental_health_T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4746</td>
<td>26.79</td>
<td>Male</td>
<td>Program B</td>
<td>97.53</td>
</tr>
<tr>
<td>3471</td>
<td>24.86</td>
<td>Male</td>
<td>Program B</td>
<td>82.72</td>
</tr>
<tr>
<td>4343</td>
<td>24.47</td>
<td>Male</td>
<td>Program C</td>
<td>101.2</td>
</tr>
<tr>
<td>3566</td>
<td>23.53</td>
<td>Female</td>
<td>Program C</td>
<td>92.74</td>
</tr>
<tr>
<td>2082</td>
<td>18.71</td>
<td>Male</td>
<td>Program C</td>
<td>87.08</td>
</tr>
<tr>
<td>3963</td>
<td>29.95</td>
<td>Other Identity</td>
<td>Program C</td>
<td>97.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mental_health_T2</th>
<th>latitude</th>
<th>longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>107.2</td>
<td>42.13</td>
<td>-83.67</td>
</tr>
<tr>
<td>103.9</td>
<td>42.05</td>
<td>-83.8</td>
</tr>
<tr>
<td>94.14</td>
<td>42.25</td>
<td>-83.63</td>
</tr>
<tr>
<td>103.4</td>
<td>42.11</td>
<td>-83.75</td>
</tr>
<tr>
<td>96.56</td>
<td>42.1</td>
<td>-83.62</td>
</tr>
<tr>
<td>92.21</td>
<td>42.34</td>
<td>-83.82</td>
</tr>
</tbody>
</table>

3 Load the Libraries

library(ggplot2) # beautiful graphs

library(ggthemes) # beautiful themes
4 First Approach (x is program; y is mental health)

There is a lot of code below. This is where we are setting up the grammatical logic of the graphing approach.

Devoting some time to setting up the initial logic of the plot will pay dividends in terms of exploring multiple geometries later on.

Note that I am adding optional scale... and theme... arguments just to make the graphs look a little nicer, but these are not an essential part of the code.

```r
myplot1 <- ggplot(clients, # the data I am using
  aes(x = program, # x is program
      y = mental_health_T2, # y is mental health
      color = program, # color is also program
      fill = program)) + # fill is also program
  labs(y = "mental health at time 2") + # labels
  scale_color_viridis_d() + # beautiful colors
  scale_fill_viridis_d() + # beautiful fills
  theme_minimal() + # minimal theme
  theme(axis.text.x = element_text(size = rel(.5))) # smaller labels
```

5 Add Geometries That Show The Average

Now that we have devoted a lot of code to setting up the grammar of the graph, it is a relatively simple matter to try out different geometries. The geometries show the average value.

5.1 Bar Chart

```r
myplot1 +
  stat_summary(fun.y = "mean", # summarize at mean
               geom = "bar") + # bar geometry
  labs(title = "Bar Chart")
```

5.2 Horizontal Bar Chart

```r
myplot1 +
  stat_summary(fun.y = "mean", # summarize at mean
               geom = "bar") + # bar geometry
  coord_flip() + # flip coordinates
  labs(title = "Horizontal Bar Chart")
```
5.3 Point Chart

myplot1 +
  stat_summary(fun.y = "mean", # summarize at mean
               geom = "point", size = 5) + # point geometry
  labs(title = "Point Chart")

5.4 “Lollipop” Chart

The segments connecting the x axis with the points, require their own geometry that has its own aesthetic.

myplot1 +
  stat_summary(fun.y = "mean",
               geom = "point",
               size = 5) +
  geom_segment(aes(x = program, # x starts at
                  xend = program, # x ends at
                  y = 0, # y starts at
                  yend = mean(mental_health_T2))) + # y ends at
  labs(title = "Lollipop Chart")

5.5 Line Chart

An extra element of the aesthetic is required for lines.

myplot1 +
  stat_summary(aes(group = 1), # line geom needs group aesthetic
               color = "black", # consistent color
               fun.y = "mean",
               geom = "line") +
  labs(title = "Line Chart")

6 Add Geometries That Show the Distribution

Now that we have devoted a lot of code to setting up the grammar of the graph, it is a relatively simple matter to try out different geometries. The geometries show the distribution of all values.

6.1 Boxplot

myplot1 + geom_boxplot(fill="white") + # boxplot geometry
  labs(title = "Boxplot")
6.2 Violin Plot

myplot1 + geom_violin() + # violinplot geometry
labs(title = "Violin Plot")

6.3 Points

myplot1 + geom_point() + # point geometry
labs(title = "Points")

6.4 Jittered Points

myplot1 + geom_jitter() + # jittered point geometry
labs(title = "Jittered Points")

6.5 Beeswarm Plot

library(ggbeeswarm) # beeswarm geometry

myplot1 + geom_beeswarm() + # beeswarm geometry
labs(title = "Beeswarm Plot")

7 Second Approach (x is mental health; facet wrap on program)

Again, there is a lot of code below. This is where we are setting up the grammatical logic of the graphing approach.

myplot2 <- ggplot(clients, # the data I am using
                   aes(x = mental_health_T2, # x is mental health
                        fill = program)) + # fill is program
           facet_wrap(~program) + # facet on this variable
           labs(x = "mental health at time 2") + # labels
           scale_color_viridis_d() + # beautiful colors
           scale_fill_viridis_d() + # beautiful fills
           theme_bw() # bw theme makes facets more clear

8 Add Geometries

However, now that we have devoted a lot of code to setting up the grammar of the graph, it is again a relatively simple matter to try out different geometries.
8.1 Histogram

myplot2 + geom_histogram() + # histogram geometry
    labs(title = "Histogram")

8.2 Density

myplot2 + geom_density() + # density geometry
    labs(title = "Density")

9  Third Approach (x is mental health; transparent geometries)

One last time, there is a lot of code below. This is where we are setting up the grammatical logic of the graphing approach.

myplot3 <- ggplot(clients, # the data I am using
    aes(x = mental_health_T2, # x is mental health
        fill = program)) + # fill is program
    labs(x = "mental health at time 2") + # labels
    scale_color_viridis_d() + # beautiful colors
    scale_fill_viridis_d() + # beautiful fills
    theme_minimal() # minimal theme

10  Add Geometries

And again, now that we have devoted a lot of code to setting up the grammar of the graph, it is again a relatively simple matter to try out different geometries.\footnote{It is important to use \(\texttt{alpha = \ldots}\) to create transparency with these \texttt{geom}s.}

10.1 Histogram

myplot3 +
    geom_histogram(alpha = .5) + # histogram geometry (transparent)
    labs(title="Histogram")

10.2 Density

myplot3 +
    geom_density(alpha = .5) + # density geometry (transparent)
    labs(title = "Density")