Telling Stories With Data: Comparing Program Outcomes with ggplot2

Andy Grogan-Kaylor

2021-03-10

Contents

1   Background

ggplot2 is a powerful graphing library that can make beautiful graphs. ggplot2 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 ggplot2 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 **mental health at time 2** is *numeric*.

2   Load the Simulated Social Service Agency Data

```
load("social_service_agency.RData") # simulated data
```

Table 1: Table continues below

ID	age	gender	program	mental_health_T1
4746	26.79	Male	Program B	97.53
3471	24.86	Male	Program B	82.72
4343	24.47	Male	Program C	101.2
3566	23.53	Female	Program C	92.74
2082	18.71	Male	Program C	87.08
3963	29.95	Other Identity	Program C	97.98

mental_health_T2	latitude	longitude
107.2	42.13	-83.67
103.9	42.05	-83.8
94.14	42.25	-83.63
103.4	42.11	-83.75
96.56	42.1	-83.62
92.21	42.34	-83.82

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.

```
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

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

5.2   Horizontal Bar Chart

```
myplot1 +
  stat_summary(fun = "mean", # summarize at mean
               geom = "bar") + # bar geometry
```
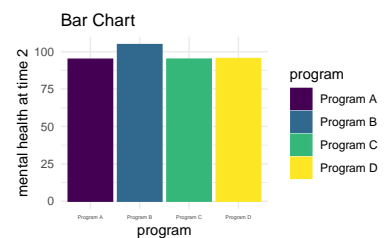

Figure 1: Bar Chart

```
  coord_flip() + # flip coordinates
  labs(title = "Horizontal Bar Chart")
```

5.3   Point Chart

```
myplot1 +
  stat_summary(fun = "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 = "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 = "mean",
               geom = "line") +
  labs(title = "Line Chart")
```

A line chart is likely *not* an appropriate way to show these program outcomes as a line chart is more appropriate when the x axis represents some kind of *time trend*.
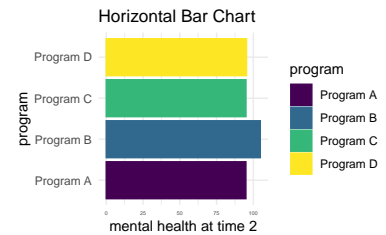

Figure 2: Horizontal Bar Chart

Figure 3: Point Chart
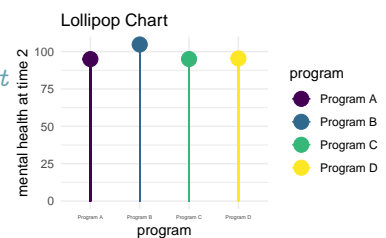
Figure 4: Lollipop Chart

Figure 5: 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.
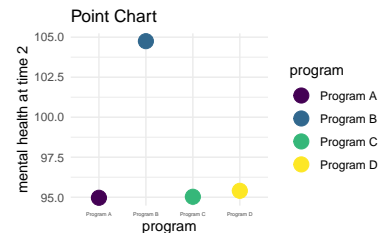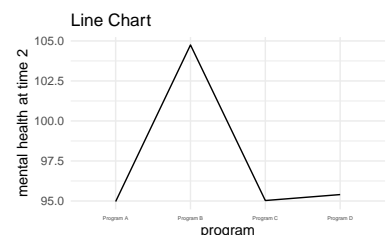
6.1   Boxplot

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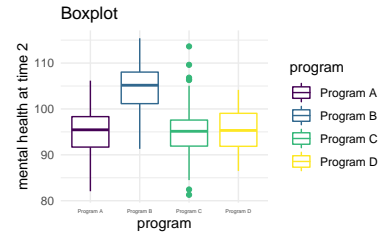
6.2   Violin Plot

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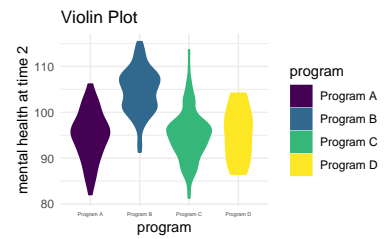
6.3   Points

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

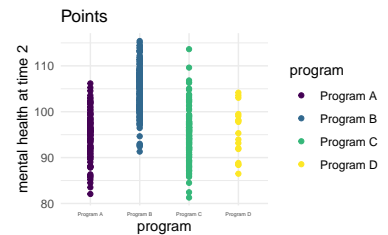## 6.4   Jittered Points

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

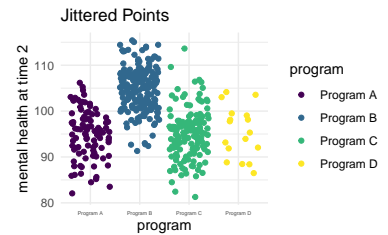## 6.5   Beeswarm Plot

```
library(ggbeeswarm) # beeswarm geometry

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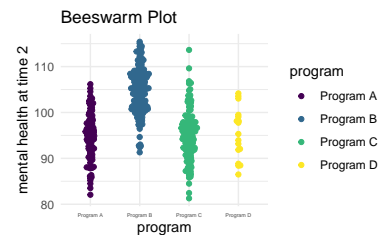

Figure 6: Boxplot

Figure 7: Violin Plot

Figure 8: Points

Figure 9: Jittered Points

Figure 10: 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")
```

Figure 11: Histogram

8.2   Density

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

Figure 12: 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
```
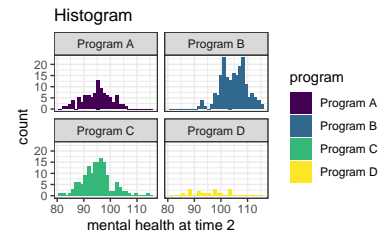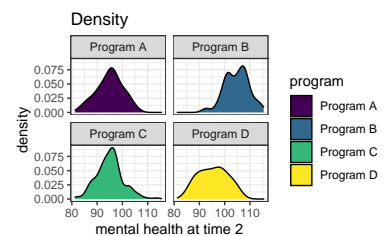
10   Add Geometries

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.[1]

10.1   Histogram

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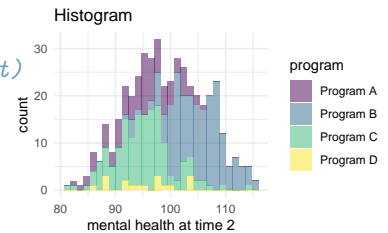
10.2   Density

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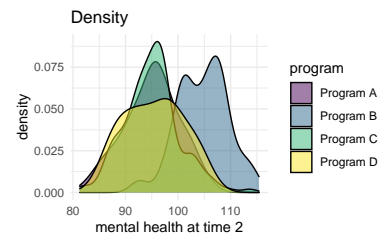

Figure 13: Histogram

Figure 14: Density