

Telling Stories With Data: Comparing Program Outcomes with ggplot2

Andy Grogan-Kaylor

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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 **outcome** is *numeric*.

In HTML versions of this document, you can see the code by clicking on the code buttons on the right hand side of the document.

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")
```

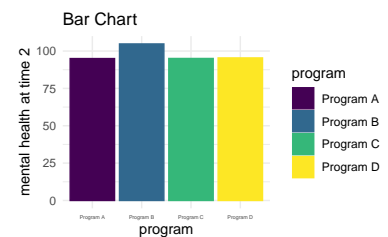


Figure 1: Bar Chart

5.2 Horizontal Bar Chart

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

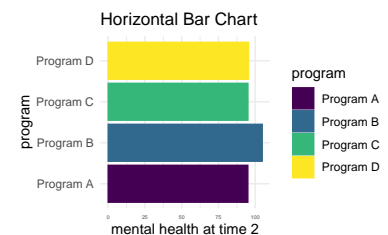


Figure 2: Horizontal Bar Chart

5.3 Point Chart

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

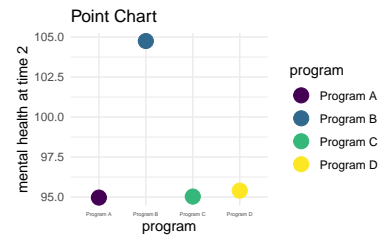


Figure 3: Point Chart

5.4 “Lollipop” Chart

The segments connecting the x axis with the points, require their own `geom` 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")
```

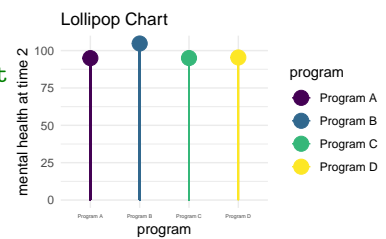


Figure 4: Lollipop Chart

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*.

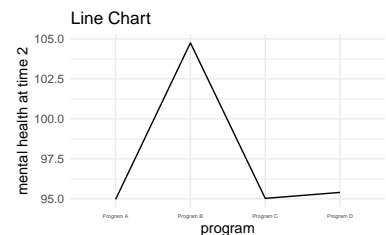


Figure 5: Line Chart

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")
```

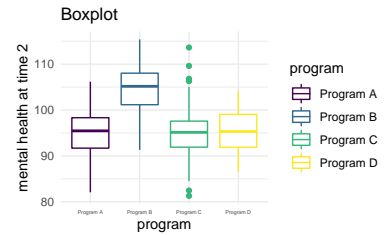


Figure 6: Boxplot

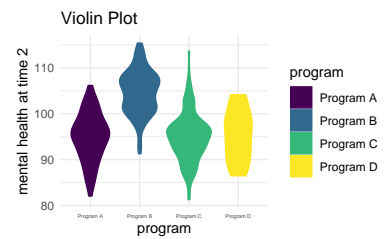


Figure 7: Violin Plot

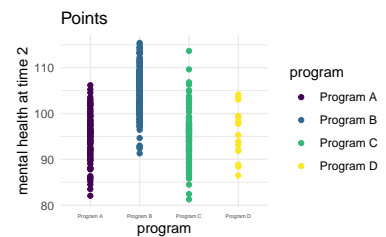


Figure 8: Points

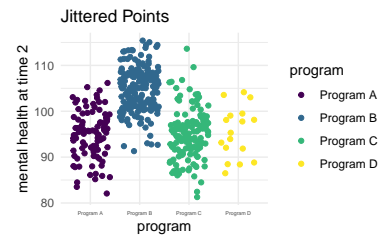


Figure 9: Jittered Points

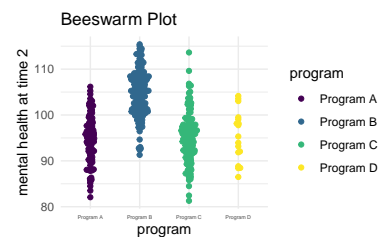


Figure 10: Beeswarm Plot

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")
```

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
```

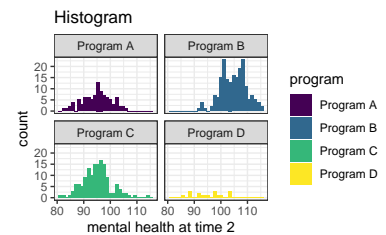


Figure 11: Histogram

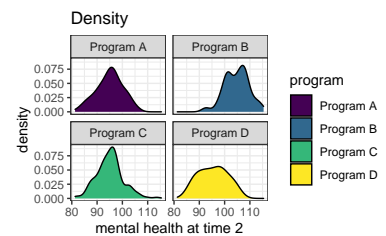


Figure 12: Density

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

¹ It is important to use (`alpha = ...`) to create transparency with these geoms.

10.1 Histogram

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

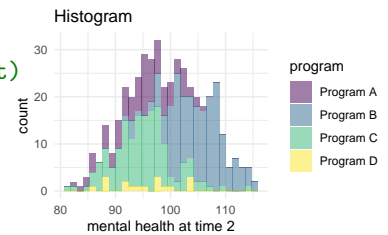


Figure 13: Histogram

10.2 Density

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

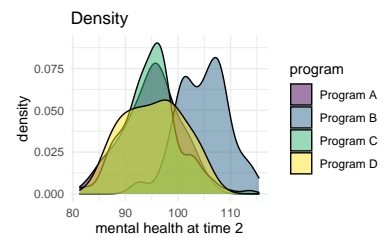


Figure 14: Density