Multilevel Visualization

Andrew Grogan-Kaylor

2024-03-24

Table of contents

List of Figures

List of Tables

1 Multilevel Visualization

1.1 Introduction

Below, I describe the use of Stata (StataCorp 2021), R (R Core Team 2023), and Julia (Bezanson et al. 2017) to visualize multilevel models.

1.2 The Data

The examples use the `simulated_multilevel_data.dta` file from *Multilevel Thinking*. Here is a direct link to download the data.

Table 1.1: Sample of Simulated Multilevel Data

country	HDI	family	id	group	physical_punishment	warmth	outcome
1	69	1	1.1	2	2	3	59.18
1	69	2	1.2	2	4	0	61.54
1	69	3	1.3	1	4	4	51.87
1	69	4	1.4	2	0	6	51.71
1	69	5	1.5	2	3	2	55.88
1	69	6	1.6	1	5	3	60.78

2 Graphs

2.1 Scatterplots

2.1.1 Stata

2.1.1.1 Get The Data

```
use simulated_multilevel_data.dta
```

2.1.1.2 Scatterplot

```
twoway scatter outcome warmth, ///
  xtitle("warmth") ytitle("outcome") ///
  title("Outcome by Parental Warmth")

quietly graph export scatter.png, replace
```

2.1.2 R

2.1.2.1 Get The Data

```
library(haven)

df <- read_dta("simulated_multilevel_data.dta")
```

2.1.2.2 Scatterplot

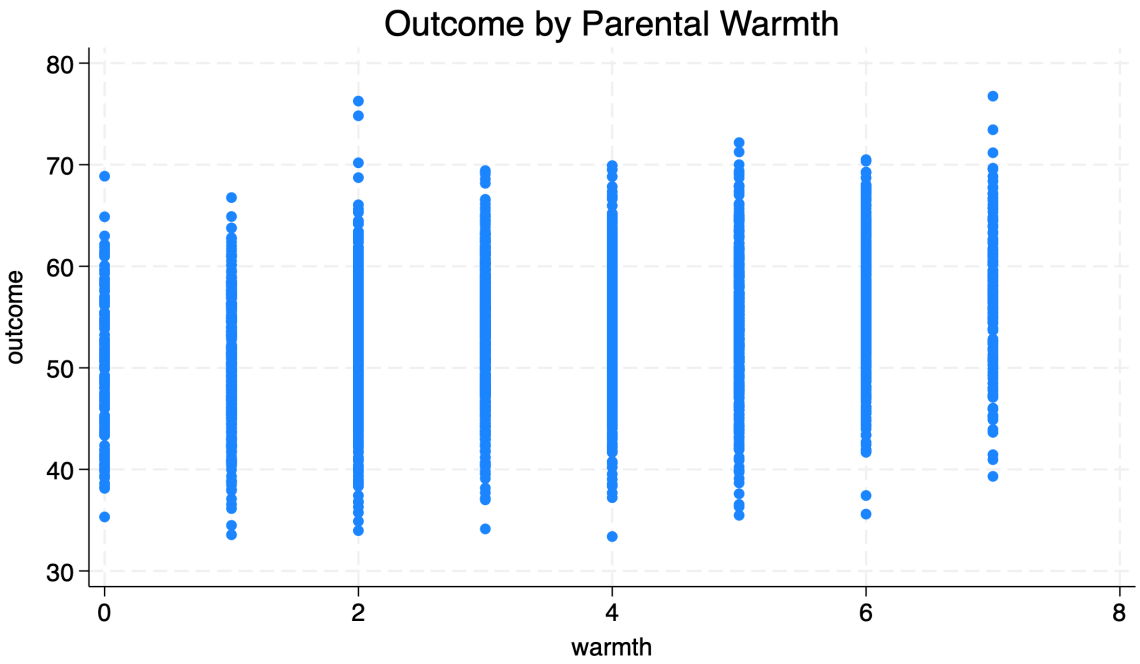

Figure 2.1: Outcome by Parental Warmth (Stata)

```r
library(ggplot2)

ggplot(df,
       aes(x = warmth,
           y = outcome)) +
  geom_point() +
  labs(title = "Outcome by Parental Warmth")
```

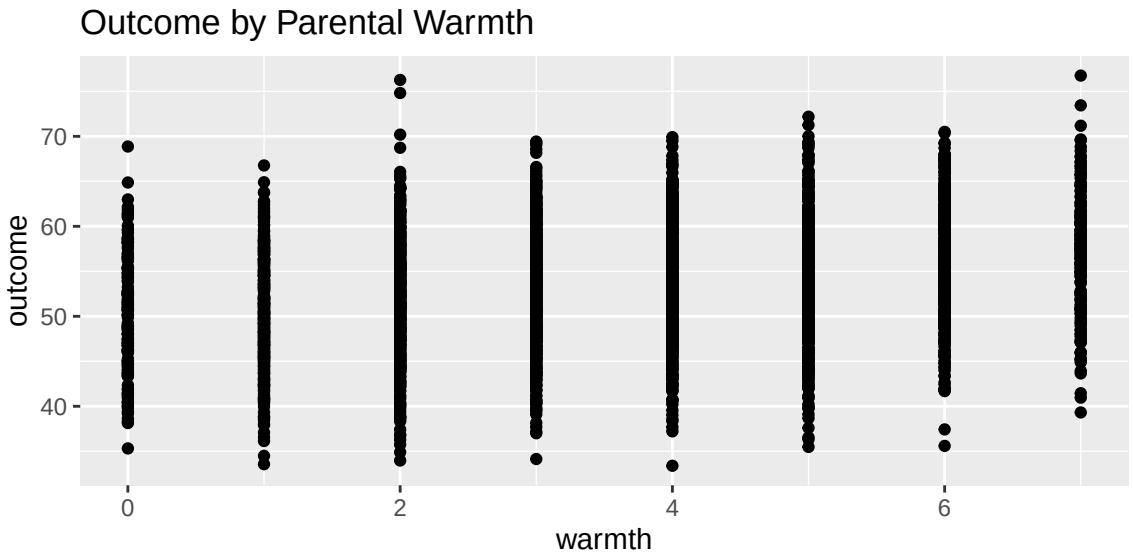

Figure 2.2: Outcome by Parental Warmth (R)

2.1.3 Julia

2.1.3.1 Get The Data

```julia
using Tables, MixedModels, StatFiles, DataFrames, CategoricalArrays, DataFramesMeta

df = DataFrame(load("simulated_multilevel_data.dta"))
```

2.1.3.2 Scatterplot

```
using StatsPlots

@df df scatter(:outcome, :warmth,
               title = "Outcome by Parental Warmth",
               ylabel = "outcome",
               xlabel = "parental warmth")
```

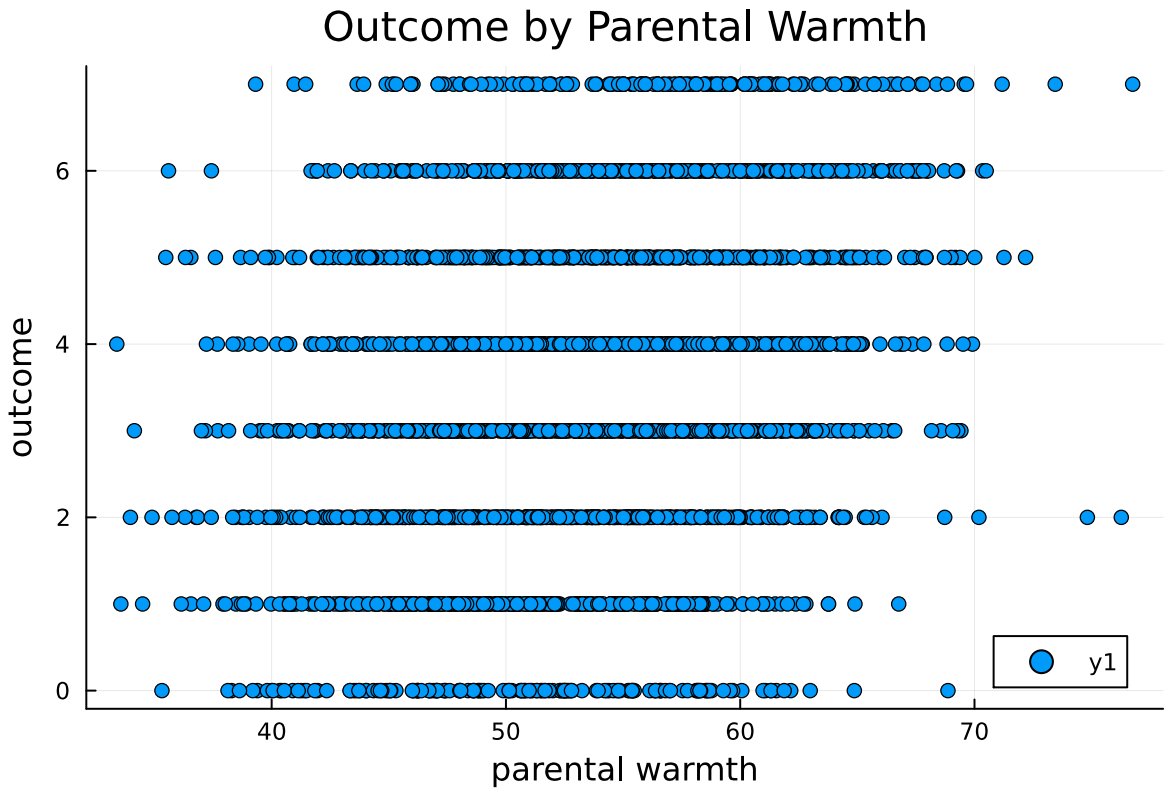

Figure 2.3: Outcome by Parental Warmth (Julia)

2.2 Line Graph

2.2.1 Stata

2.2.1.1 Get The Data

```
use simulated_multilevel_longitudinal_data.dta
```

2.2.1.2 Line Graph

```
twoway lfit outcome t, ///
  xtitle("time") ytitle("outcome") ///
  title("Outcome by Time")

quietly graph export lfitlongitudinal.png, replace
```

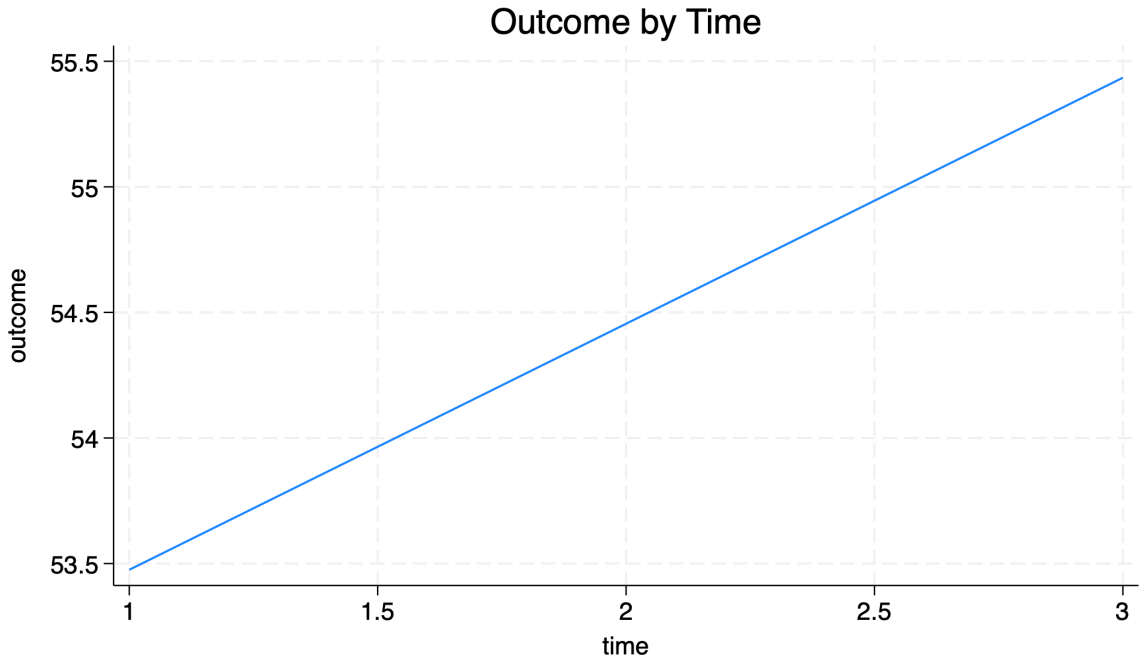

Figure 2.4: Outcome by Parental Warmth (Stata)

2.2.2 R

2.2.2.1 Get The Data

```
use simulated_multilevel_longitudinal_data.dta
```

2.2.2.2 Line Graph

```
twoway lfit outcome t, ///
  xtitle("time") ytitle("outcome") ///
  title("Outcome by Time")

quietly graph export lfitlongitudinal.png, replace
```

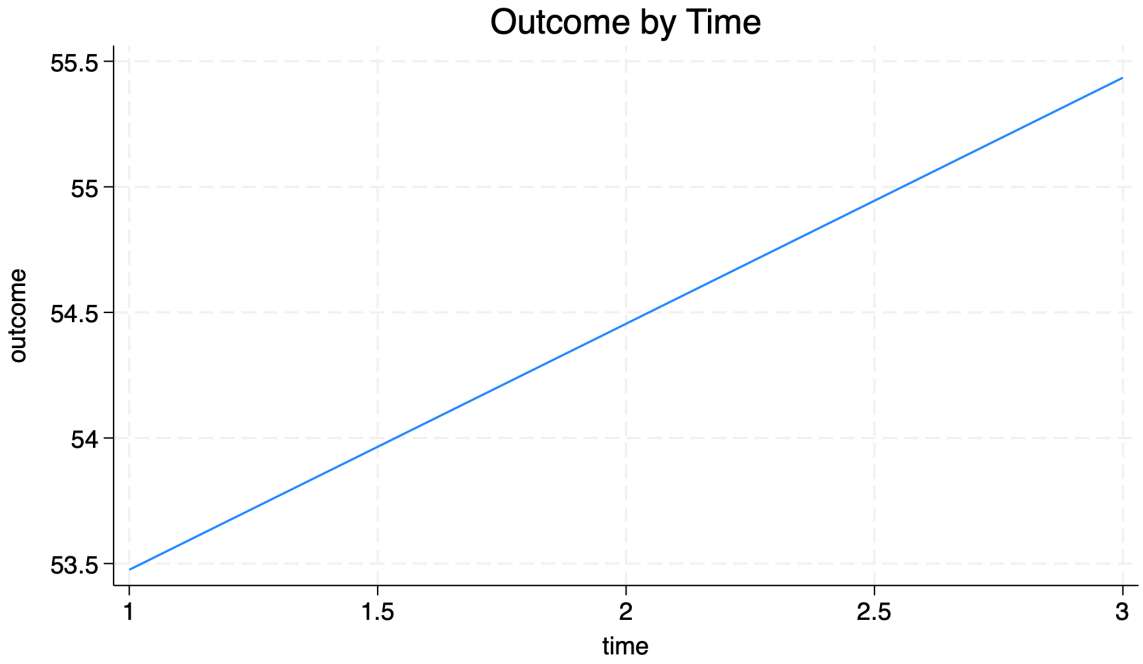

Figure 2.5: Outcome by Parental Warmth (Stata)

2.2.3 Julia

2.2.3.1 Get The Data

```
using Tables, MixedModels, StatFiles, DataFrames, CategoricalArrays, DataFramesMeta

dfL = DataFrame(load("simulated_multilevel_longitudinal_data.dta"))
```

2.2.3.2 Line Graph

To make our plot with a smoother in Julia, we set the `markercolor` and `markerstrokecolor` to be *white*, and the `smooth` option to `:true`.

```
using StatsPlots

@df dfL scatter(:outcome, :t,
                title = "Outcome by Time",
                ylabel = "outcome",
                xlabel = "time",
                markercolor = "white",
                markerstrokecolor = "white",
                smooth=:true)
```

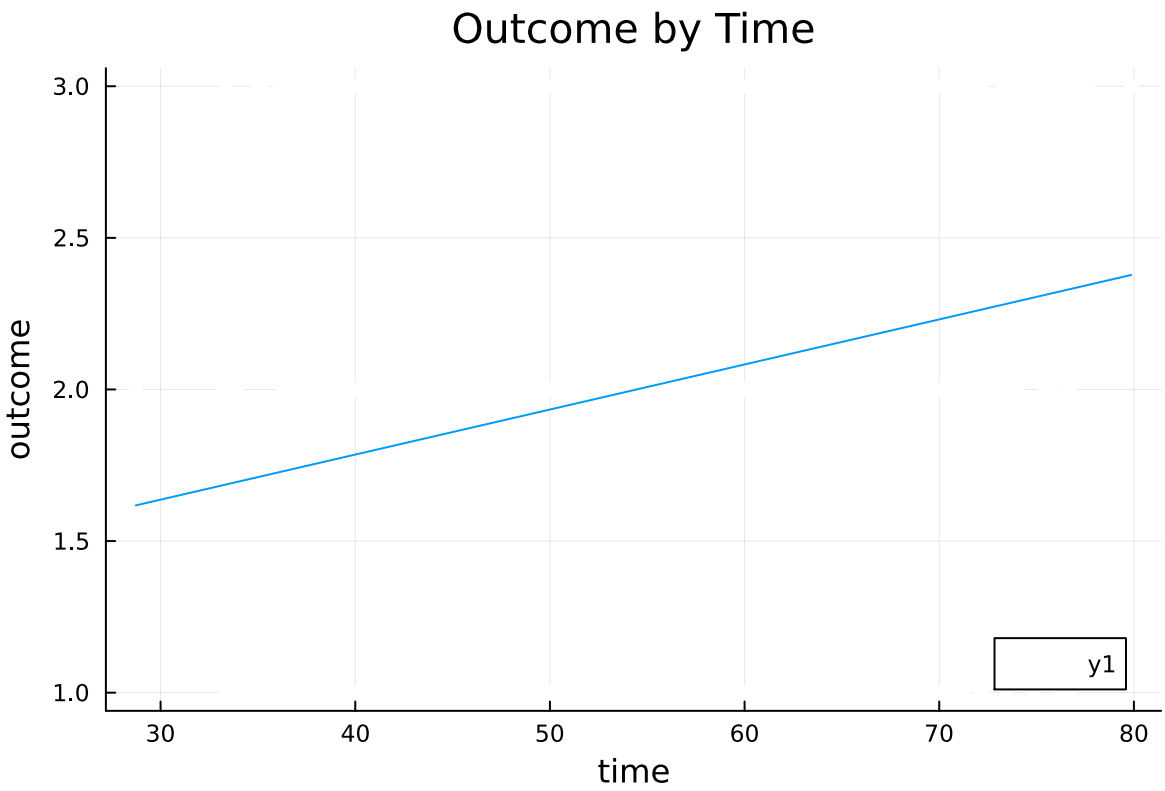

Figure 2.6: Outcome by Parental Warmth (Julia)

2.3 Spaghetti Plots

2.3.1 Stata

2.3.2 R

2.3.3 Julia

References

Bezanson, Jeff, Alan Edelman, Stefan Karpinski, and Viral B. Shah. 2017. "Julia: A Fresh Approach to Numerical Computing." *SIAM Review* 59 (1): 65–98. https://doi.org/10.1137/141000671.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

StataCorp. 2021. *Stata 17 Graphics Reference Manual*. Stata Press.