Multilevel Visualization

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1 Multilevel Visualization

> "Persist and verify… The power that we abdicate to others out of our insecurity - to others who insult us with their faux-intuition or their authoritarian smugness - that comes back to hurt us so deeply… But the power we wrest from our own certitude - that saves us." (Cash 2017)

> "Mathematical Science shows us what is. It is the language of unseen relations between things. But to use & apply that language we must be able fully to appreciate, to feel, to seize, the unseen, the unconscious. Imagination too shows us what is, the is that is beyond the senses." (Lovelace 1992)

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

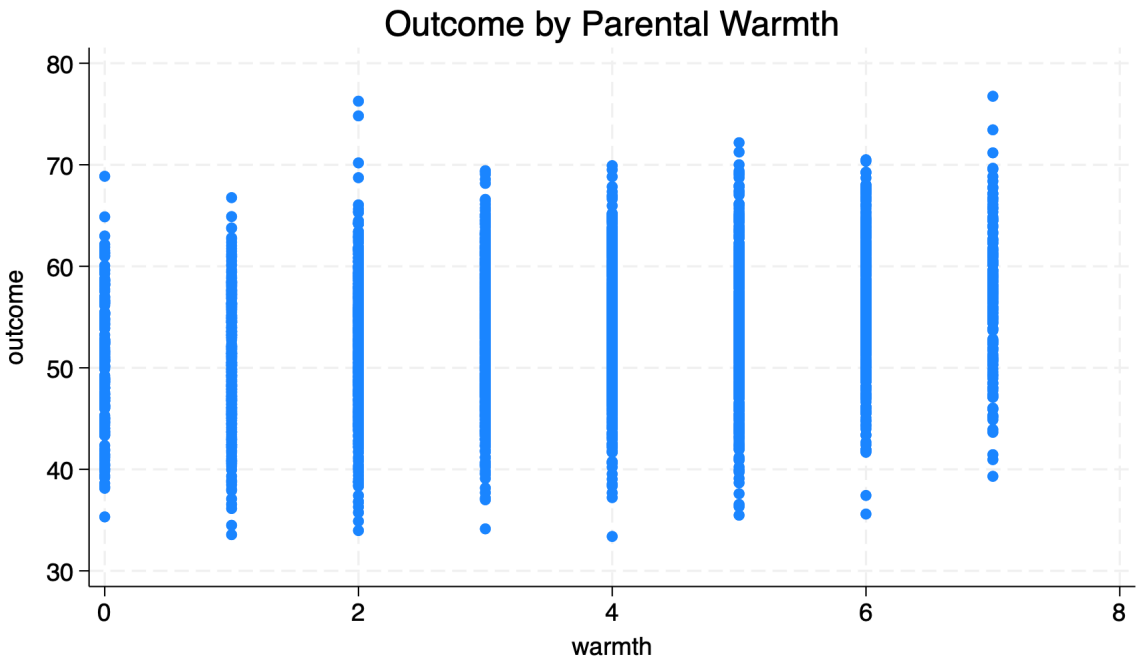

Figure 2.1: Outcome by Parental Warmth (Stata)

```r
library(ggplot2)

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

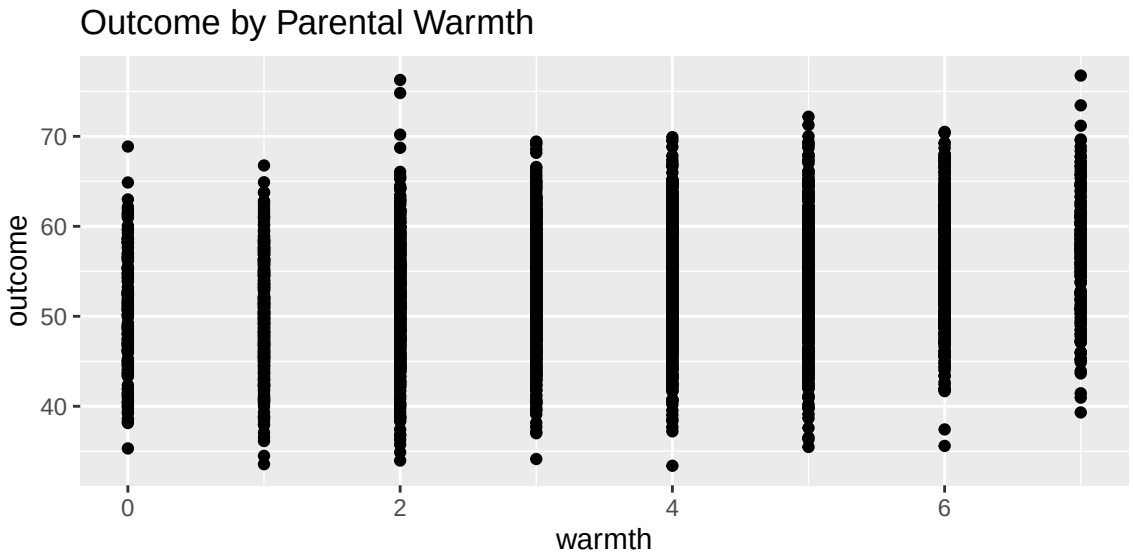

Figure 2.2: Outcome by Parental Warmth (R)

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

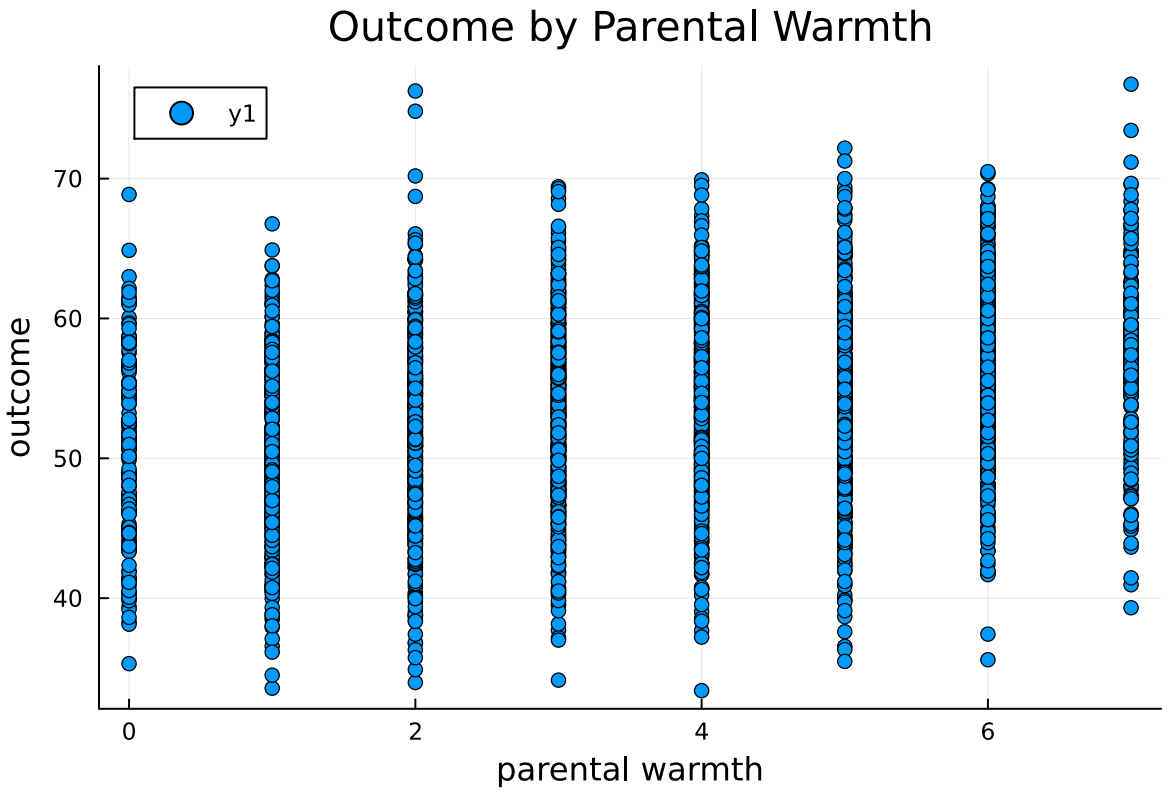

Figure 2.3: Outcome by Parental Warmth (Julia)

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
```

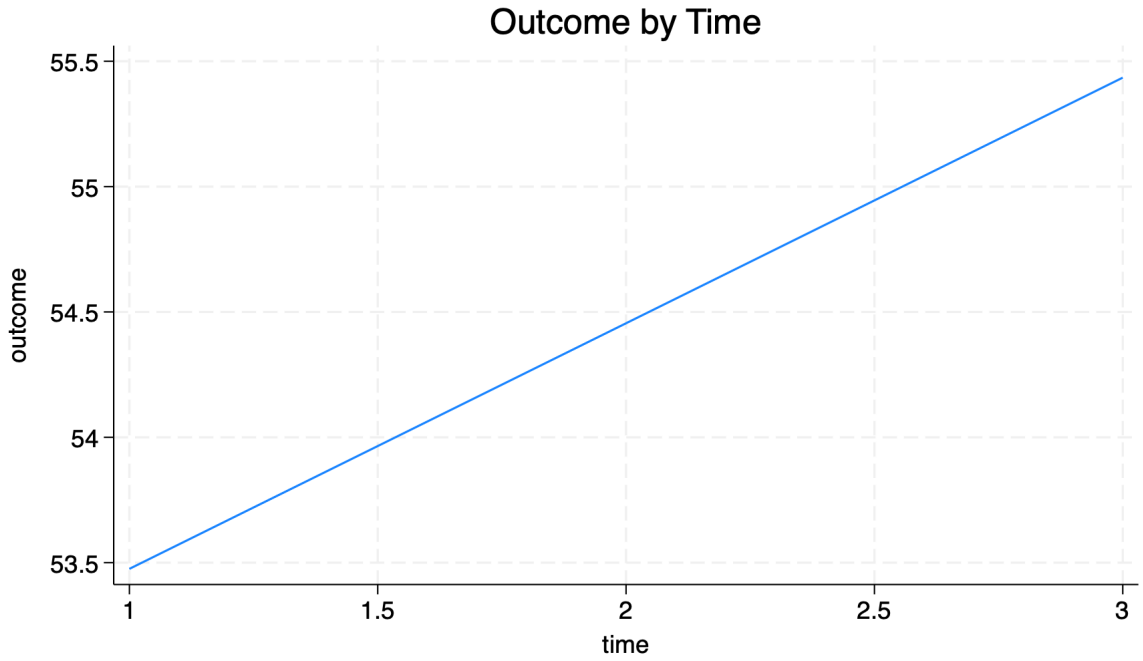

Figure 2.4: Outcome by Parental Warmth (Stata)

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
```

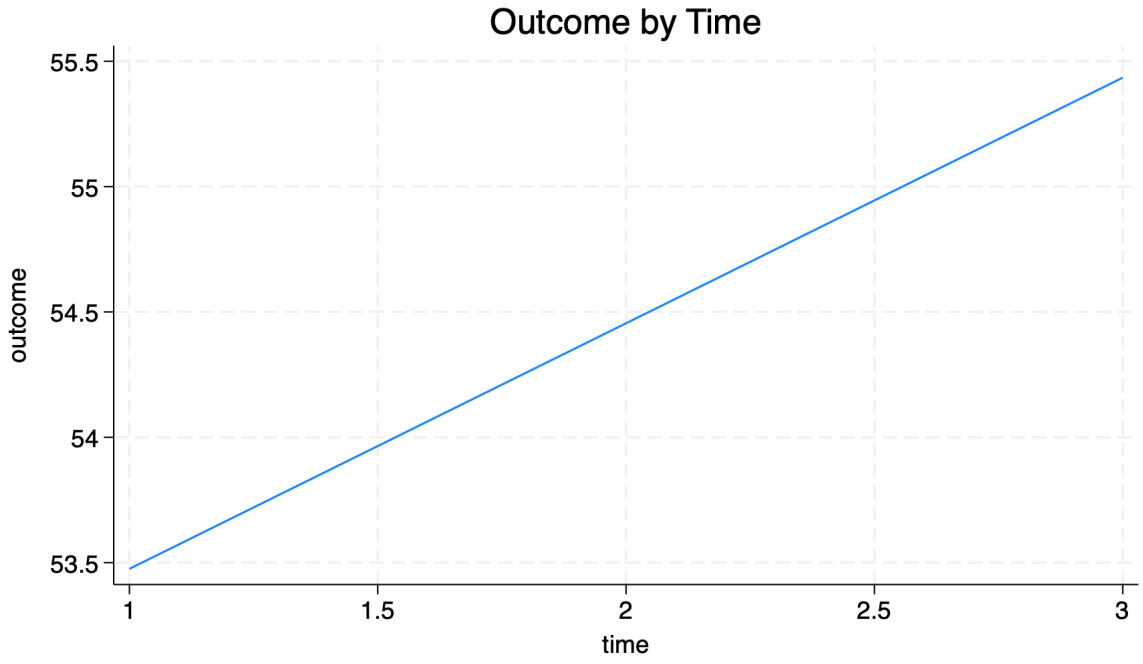

Figure 2.5: Outcome by Parental Warmth (Stata)

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

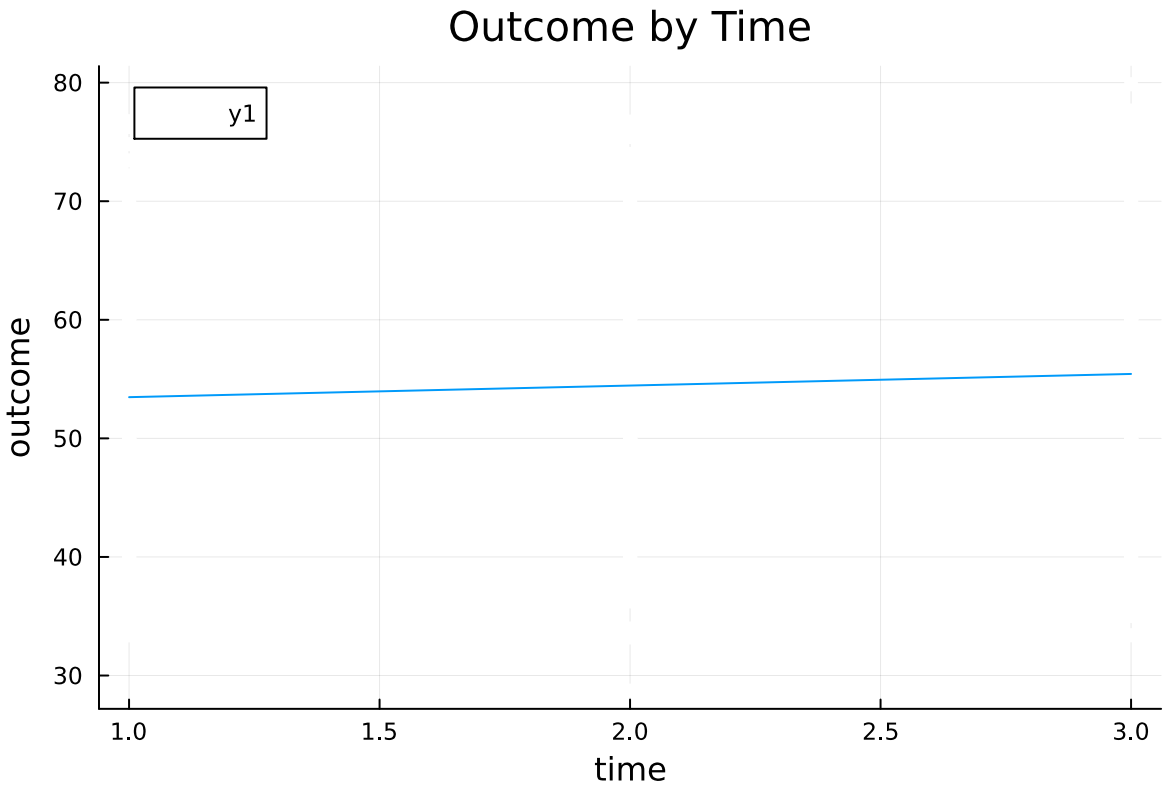

Figure 2.6: Outcome by Parental Warmth (Julia)

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.

Cash, Roseanne. 2017. "Roseanne Cash Reads "Power" by Adrienne Rich." In *The Universe in Verse*.

Lovelace, Ada King. 1992. *Ada: The Enchantress of Numbers: A Selection from the Letters of Lord Byron's Daughter and Her Description of the First Computer*. Edited by Betty A. Toole. Strawberry Press.

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