Multilevel Visualization

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# 1. Multilevel Visualization

“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](https://www.stata.com/) (StataCorp 2021), [R](https://www.r-project.org/) (R Core Team 2023), and [Julia](https://www.julialang.org/) (Bezanson et al. 2017) to visualize multilevel models.

## 1.2 The Data

The examples use the simulated\_multilevel\_data.dta file from [*Multilevel Thinking*](https://agrogan1.github.io/multilevel-thinking/simulated-multi-country-data.html). Here is a [direct link](https://github.com/agrogan1/multilevel-multilingual/raw/main/simulated_multilevel_data.dta) to download the data.

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| 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

### Stata

#### 2.1.0.1 Get The Data

use simulated\_multilevel\_data.dta

#### 2.1.0.2 Scatterplot

twoway scatter outcome warmth, ///  
 xtitle("warmth") ytitle("outcome") ///  
 title("Outcome by Parental Warmth")   
  
quietly graph export scatter.png, replace

|  |
| --- |
| Figure 2.1: Outcome by Parental Warmth (Stata) |

### R

#### 2.1.0.3 Get The Data

library(haven)  
  
df <- read\_dta("simulated\_multilevel\_data.dta")

#### 2.1.0.4 Scatterplot

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) |

### Julia

#### 2.1.0.5 Get The Data

using Tables, MixedModels, StatFiles, DataFrames, CategoricalArrays, DataFramesMeta  
  
df = DataFrame(load("simulated\_multilevel\_data.dta"))

#### 2.1.0.6 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

### Stata

#### 2.2.0.1 Get The Data

use simulated\_multilevel\_longitudinal\_data.dta

#### 2.2.0.2 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) |

### R

#### 2.2.0.3 Get The Data

use simulated\_multilevel\_longitudinal\_data.dta

#### 2.2.0.4 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) |

### Julia

#### 2.2.0.5 Get The Data

using Tables, MixedModels, StatFiles, DataFrames, CategoricalArrays, DataFramesMeta  
  
dfL = DataFrame(load("simulated\_multilevel\_longitudinal\_data.dta"))

#### 2.2.0.6 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

### Stata

### R

### 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>.

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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