

# Multilevel Structure

true

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## 1 Call The Libraries

```
library(ggplot2) # beautiful graphs

# library(gganimate) # animated ggplots

library(lme4) # MLM

# library(pander) # nice tables

library(sjPlot) # nice tables for MLM
```

## 2 Simulate Some Data

```
e <- rnorm(10, 0, 1) # error

# group 1

group1 <- rep(1, 10)

x1 <- seq(1,10)

y1 <- 10 + -1 * x1 + e

# group 2
```

```

group2 <- rep(2, 10)

x2 <- seq(11, 20)

y2 <- 30 + -1 * x2 + e

# group 3

group3 <- rep(3, 10)

x3 <- seq(21, 30)

y3 <- 50 + -1 * x3 + e

# combine into a dataframe

x <- c(x1, x2, x3)

y <- c(y1, y2, y3)

group <- factor(c(group1, group2, group3))

mydata <- data.frame(x, y, group)

```

## 3 Graphs

### 3.1 A “Naive” Graph That Is Unaware of The Structure Of The Data

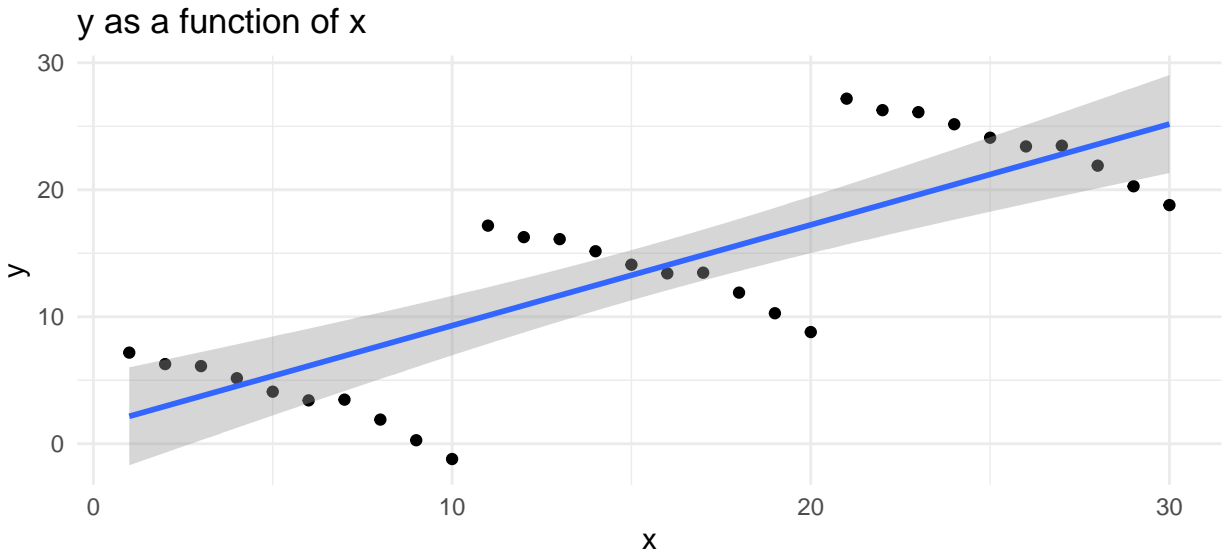
```

library(ggplot2)

p0 <- ggplot(mydata,
             aes(x = x,
                 y = y)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(title = "y as a function of x") +
  theme_minimal()

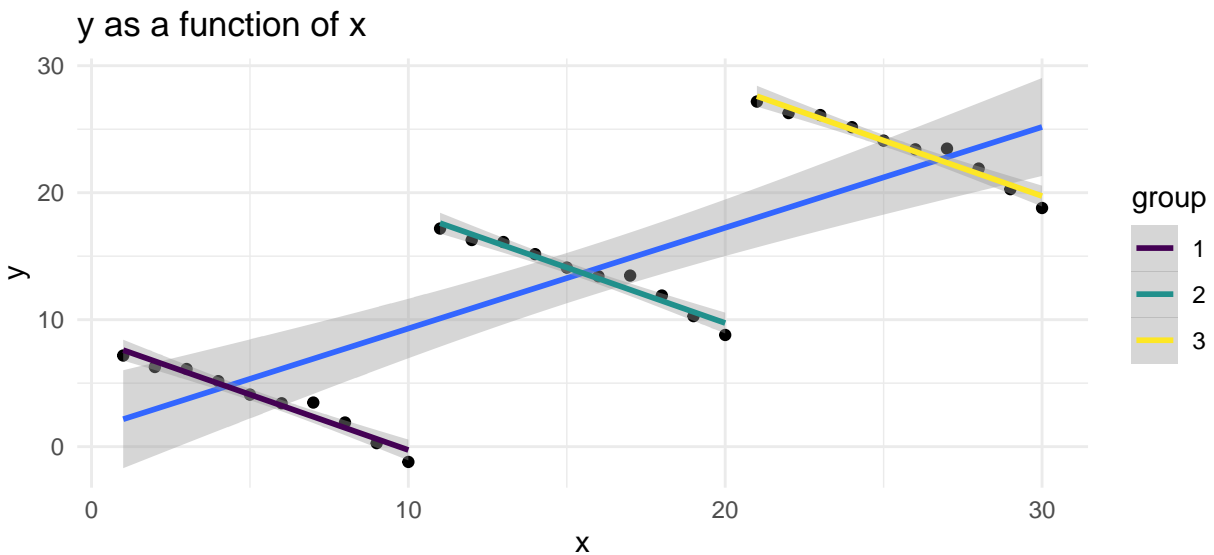
p0 # replay

```



### 3.2 A Graph That Is Aware Of The Structure Of The Data

```
p0 + geom_smooth(aes(color = group), method = "lm") + scale_color_viridis_d()
```



## 4 Regressions

### 4.1 OLS

The multilevel model is not aware of the grouped structure of the data, and the coefficient for  $x$  reflects this.

```
myOLS <- lm(y ~ x, data = mydata)
```

```
sjPlot::tab_model(myOLS,
  show.se = TRUE,
```

```
show.ci = FALSE,
show.stat = TRUE)
```

```
y
Predictors
Estimates
std. Error
Statistic
p
(Intercept)
1.37
1.98
0.69
0.495
x
0.79
0.11
7.12
<0.001
Observations
30
R2 / R2 adjusted
0.644 / 0.631
```

## 4.2 MLM

The multilevel model is aware of the grouped structure of the data, and the coefficient for  $x$  reflects this.

```
myMLM <- lmer(y ~ x + (1 | group), data = mydata)
```

```
sjPlot::tab_model(myMLM,
                   show.se = TRUE,
                   show.ci = FALSE,
                   show.stat = TRUE)
```

```
y
Predictors
Estimates
std. Error
Statistic
```

p  
 (Intercept)  
 27.19  
 10.83  
 2.51  
 0.019  
 x  
 -0.87  
 0.04  
 -23.59  
 <0.001  
 Random Effects  
 2  
 0.34  
 00 group  
 350.76  
 ICC  
 1.00  
 N group  
 3  
 Observations  
 30  
 Marginal R2 / Conditional R2  
 0.144 / 0.999