BIOS6643. L07: Random effects

Notes

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.0.4     v stringr 1.4.0
## v tidyr   1.1.2     v forcats 0.5.1
## v readr   1.4.0

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()

##
## Attaching package: 'nlme'

## The following object is masked from 'package:dplyr':
##
##     collapse

## Loading required package: Matrix

##
## Attaching package: 'Matrix'

## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack

##
## Attaching package: 'lme4'

## The following object is masked from 'package:nlme':
##
##     lmList
```

Example 5: Prospective randomized trial

STEPPED-CARE randomized trial. The dataset we will use the class resembles the trial.

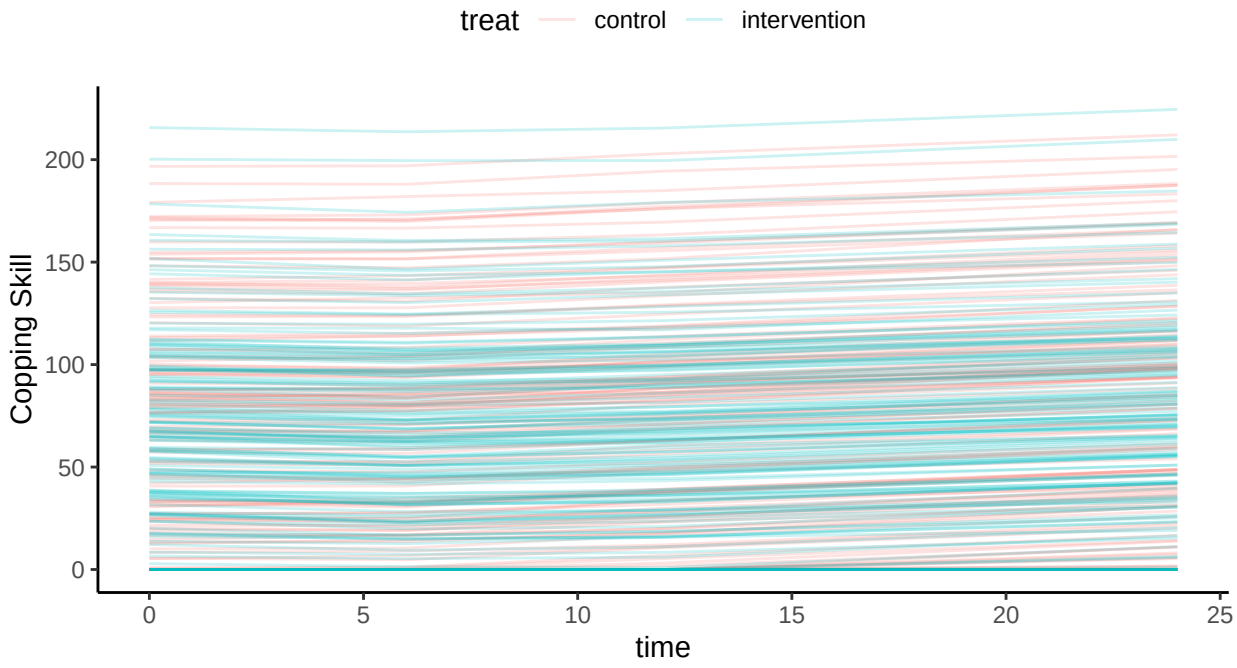
- A behavioral intervention was tested versus usual care in 286 patients with lung or head and neck cancer.

- Population: low income patients in the Denver area across 5 hospitals
- Primary outcomes: anxiety, depression and coping skills scores
- Outcomes were measured at baseline, and at 6, 12 and 24 weeks

```
# Read in data
dat.step <- read.csv("/Users/juarezce/Documents/OneDrive - The University of Colorado Denver/BIOS6643/B

head(dat.step, 3)
```

```
##   id time   treat time6 time12 time24     cops
## 1  1    0 control     0      0      0 83.26686
## 2  1    6 control     1      0      0 81.52480
## 3  1   12 control     0      1      0 88.36082
```



Using nlme package to fit models with the Stepped Care data

```
## parameterization 1
dat.step$time <- as.factor(dat.step$time)

step.lme <- lme(cops ~  time + treat:time-1,
            random= ~ 1 | id, data = dat.step)
summary(step.lme)
```

```
## Linear mixed-effects model fit by REML
##   Data: dat.step
##        AIC      BIC    logLik
##   7287.948 7338.301 -3633.974
##
## Random effects:
##  Formula: ~1 | id
##         (Intercept) Residual
## StdDev:    51.26149 2.240207
##
## Fixed effects:  cops ~ time + treat:time - 1
##                              Value Std.Error  DF   t-value p-value
## time0                    65.26599  4.290793 851 15.210708  0.0000
## time6                    65.15692  4.290793 851 15.185287  0.0000
## time12                   69.36949  4.290793 851 16.167058  0.0000
## time24                   77.67254  4.290793 851 18.102143  0.0000
## time0:treatintervention   1.85187  6.068097 851  0.305181  0.7603
## time6:treatintervention  -0.22155  6.068097 851 -0.036510  0.9709
## time12:treatintervention -2.32464  6.068097 851 -0.383092  0.7017
## time24:treatintervention -3.83589  6.068097 851 -0.632140  0.5275
##  Correlation:
##                          time0  time6  time12 time24 tm0:tr tm6:tr tm12:t
## time6                     0.998
## time12                    0.998  0.998
## time24                    0.998  0.998  0.998
## time0:treatintervention  -0.707 -0.706 -0.706 -0.706
## time6:treatintervention  -0.706 -0.707 -0.706 -0.706  0.998
## time12:treatintervention -0.706 -0.706 -0.707 -0.706  0.998  0.998
## time24:treatintervention -0.706 -0.706 -0.706 -0.707  0.998  0.998  0.998
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -3.72260623 -0.35682499 -0.01061719  0.43666407  1.97296829
##
## Number of Observations: 1144
## Number of Groups: 286
```

```
beta <- fixed.effects(step.lme)  #  may use fixef(step.lme)
b <- random.effects(step.lme)    #  random effects; may use ranef(step.lme)
head(b,3)
```

```
##   (Intercept)
## 1    18.49011
## 2    25.33704
## 3   -20.64971
```

```
se.beta <- sqrt(diag(step.lme$varFix))
## Recall step.lme$varFix provides the var-cov of the fixed coefficients of model (beta)
cov <- step.lme$varFix

G <- getVarCov(step.lme, type="random.effects")   #  G matrix
sigma2 <- step.lme$sigma^2  # sigma^2
R <- getVarCov(step.lme, type="conditional", individual=1)   # R_i
V <- getVarCov(step.lme, type="marginal", individual=1)   # V_i
```

Using lme4 package to fit models with the Stepped Care data

- **lme4** is more computationally efficient than **nlme**
- **lme4** does not currently implement **nlme**'s features for modeling heteroscedasticity and cor- relation of residuals.
- **lme4** includes generalized linear mixed model (GLMM) capabilities, via the **glmer** function.

```
## parameterization 1
library(lme4) ## lme4 seems to be more computationally efficient than nlme
step.lmer <- lmer(cops ~ -1 + time + treat:time-1 + (1| id),
                      REML=FALSE,data=dat.step)
summary(step.lmer)
```

```
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: cops ~ -1 + time + treat:time - 1 + (1 | id)
##    Data: dat.step
##
##      AIC      BIC   logLik deviance df.resid
##   7291.1   7341.5  -3635.6   7271.1     1134
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.7357 -0.3581 -0.0107  0.4382  1.9799
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 2609.365 51.082
##  Residual               4.983  2.232
## Number of obs: 1144, groups:  id, 286
##
## Fixed effects:
##                           Estimate Std. Error t value
## time0                      65.2660     4.2758  15.264
## time6                      65.1569     4.2758  15.239
## time12                     69.3695     4.2758  16.224
## time24                     77.6725     4.2758  18.166
## time0:treatintervention     1.8519     6.0468   0.306
## time6:treatintervention   -0.2215     6.0468  -0.037
## time12:treatintervention  -2.3246     6.0468  -0.384
## time24:treatintervention  -3.8359     6.0468  -0.634
##
## Correlation of Fixed Effects:
##             time0  time6  time12 time24 tm0:tr tm6:tr tm12:t
## time6        0.998
## time12       0.998  0.998
## time24       0.998  0.998  0.998
## tm0:trtntrv -0.707 -0.706 -0.706 -0.706
## tm6:trtntrv -0.706 -0.707 -0.706 -0.706  0.998
## tm12:trtntr -0.706 -0.706 -0.707 -0.706  0.998  0.998
## tm24:trtntr -0.706 -0.706 -0.706 -0.707  0.998  0.998  0.998
```

```
beta.lmer <- fixef(step.lmer)
cov.lmer <- vcov(step.lmer) ## var-cov matrix of fixed coeff
```

```r
b.lmer <- ranef(step.lmer) ## random effects
sigma2.lmer <- sigma(step.lmer)^2

vc <- VarCorr(step.lmer)

print(vc, comp="Variance")
```

```
##  Groups   Name        Variance
##  id       (Intercept) 2609.3645
##  Residual               4.9834
```

‘‘‘