Assignment 04

Marwin Carmo

library(nlme)  
library(car)

## Loading required package: carData

mydata <- read.csv("../data/mydata.csv")  
# removing NAs  
mydata <- mydata[!is.na(mydata$insomnia\_severity), ]  
# convert the time variable to factor  
mydata$redcap\_event\_name <- factor(mydata$redcap\_event\_name)

## (1) Select a variable in your data for modeling over time. (1 variable, at least 3 occasions). Use the same variable and data as Assignment 3.

Consistent with last assignments 1 and 2, I will work with the outcome of insomnia severity.

## (2) Covariance Pattern Model

### a. Select 3-5 covariance patterns you deem reasonable for your data

mat <- with(mydata, matrix(c(insomnia\_severity[redcap\_event\_name==1],   
 insomnia\_severity[redcap\_event\_name==2],   
 insomnia\_severity[redcap\_event\_name==3]), ncol = 3))  
var(mat)

## [,1] [,2] [,3]  
## [1,] 16.5638882 -0.3624438 -2.137106  
## [2,] -0.3624438 39.0450391 -5.962775  
## [3,] -2.1371063 -5.9627753 37.880085

cor(mat)

## [,1] [,2] [,3]  
## [1,] 1.00000000 -0.01425202 -0.08531777  
## [2,] -0.01425202 1.00000000 -0.15504581  
## [3,] -0.08531777 -0.15504581 1.00000000

### b. Use the gls function in the nlme package to run covariance pattern models to test whether the means are equal across measurement occasions.

## Compound symmetry  
mCS <- gls(insomnia\_severity ~ redcap\_event\_name, corr = corCompSymm(form = ~1|record\_id), method="ML",data=mydata)  
  
## AR1  
mAR1 <- gls(insomnia\_severity ~ redcap\_event\_name, corr = corAR1(form = ~1|record\_id), method="ML", data=mydata)  
  
## CS with heterogeneous variances  
mCSh <- gls(insomnia\_severity ~ redcap\_event\_name, corr = corCompSymm(form = ~1|record\_id),   
 weights = varIdent(form = ~ 1 | redcap\_event\_name), method="ML",data=mydata)  
  
## AR1 with heterogeneous variances  
mAR1h <- gls(insomnia\_severity ~ redcap\_event\_name, corr = corAR1(form = ~1|record\_id),  
 weights = varIdent(form = ~ 1 | redcap\_event\_name), method="ML", data=mydata)  
  
## Unstructured  
mUN <- gls(insomnia\_severity ~ redcap\_event\_name, corr = corSymm(form = ~1|record\_id),  
 weights = varIdent(form = ~ 1 | redcap\_event\_name),  
 method="ML",data=mydata)

## c. Assess the fit of the covariance patterns using AIC and BIC, and determine the best fitting covariance pattern model

anova(mCS, mAR1, mCSh, mAR1h, mUN)

## Model df AIC BIC logLik Test L.Ratio p-value  
## mCS 1 5 3649.441 3671.566 -1819.721   
## mAR1 2 5 3643.094 3665.218 -1816.547   
## mCSh 3 7 3615.629 3646.603 -1800.814 2 vs 3 31.46486 <.0001  
## mAR1h 4 7 3618.722 3649.696 -1802.361   
## mUN 5 9 3568.352 3608.176 -1775.176 4 vs 5 54.37059 <.0001

Based on AIC and BIC, the unstructured covariance model provided the best fit to the data compared to the other covariance structures.

### d. Make a table including the omnibus test results, fit indices, and fixed effects estimates of the best fitting model

modelsummary::modelsummary(mUN)

|  |  |
| --- | --- |
| (Intercept) | 19.300 |
|  | (0.271) |
| redcap\_event\_name2 | -6.968 |
|  | (0.387) |
| redcap\_event\_name3 | -7.094 |
|  | (0.385) |
| Num.Obs. | 617 |
| R2 | 0.286 |
| AIC | 3568.4 |
| BIC | 3608.2 |
| RMSE | 5.34 |

### e. Write a few sentences reporting the model selection procedure and results of the best fitting model.

## (3) Repeated Measures ANOVA with Groups/Time-Invariant Covariate

### a. Select a grouping variable (e.g., sex) or time-invariant covariate

I will use sex as the time-invariant covariate

mydata$sex <- factor(mydata$sex)

### b. Use the gls function with compound symmetry or unstructured covariance pattern to run repeated measures ANOVA with the grouping variable or time-invariant covariate, test for an interaction effect with time

# contrasts for unequally spaced time  
#contrasts(mydata$redcap\_event\_name) <- contr.poly(c(0, 1.5, 6))  
  
mUNb <- gls(insomnia\_severity ~ redcap\_event\_name\*sex, corr = corSymm(form = ~1|record\_id),  
 weights = varIdent(form = ~ 1 | redcap\_event\_name),  
 method="ML",data=mydata)  
anova(mUNb)

## Denom. DF: 611   
## numDF F-value p-value  
## (Intercept) 1 4772.286 <.0001  
## redcap\_event\_name 2 193.493 <.0001  
## sex 1 0.413 0.5209  
## redcap\_event\_name:sex 2 0.167 0.8462

### c. Test for 1 to 2 contrasts with correct spacing

# contrasts for unequally spaced time  
contrasts(mydata$redcap\_event\_name) <- contr.poly(c(0, 1.5, 6))  
  
mUNc <- gls(insomnia\_severity ~ redcap\_event\_name\*sex, corr = corSymm(form = ~1|record\_id),  
 weights = varIdent(form = ~ 1 | redcap\_event\_name),  
 method="ML",data=mydata)  
summary(mUNc)

## Generalized least squares fit by maximum likelihood  
## Model: insomnia\_severity ~ redcap\_event\_name \* sex   
## Data: mydata   
## AIC BIC logLik  
## 3573.599 3626.697 -1774.799  
##   
## Correlation Structure: General  
## Formula: ~1 | record\_id   
## Parameter estimate(s):  
## Correlation:   
## 1 2   
## 2 0.428   
## 3 0.501 0.768  
## Variance function:  
## Structure: Different standard deviations per stratum  
## Formula: ~1 | redcap\_event\_name   
## Parameter estimates:  
## 1 2 3   
## 1.000000 1.425869 1.496720   
##   
## Coefficients:  
## Value Std.Error t-value p-value  
## (Intercept) 14.649513 0.3612217 40.55546 0.0000  
## redcap\_event\_name.L -5.103294 0.3121763 -16.34747 0.0000  
## redcap\_event\_name.Q 2.822590 0.2675180 10.55103 0.0000  
## sex2 -0.158371 0.7357927 -0.21524 0.8297  
## redcap\_event\_name.L:sex2 0.367929 0.6399642 0.57492 0.5656  
## redcap\_event\_name.Q:sex2 -0.116165 0.5438106 -0.21361 0.8309  
##   
## Correlation:   
## (Intr) rd\_\_.L rd\_\_.Q sex2 r\_\_.L:  
## redcap\_event\_name.L 0.550   
## redcap\_event\_name.Q -0.270 -0.300   
## sex2 -0.491 -0.270 0.133   
## redcap\_event\_name.L:sex2 -0.268 -0.488 0.146 0.544   
## redcap\_event\_name.Q:sex2 0.133 0.148 -0.492 -0.250 -0.272  
##   
## Standardized residuals:  
## Min Q1 Med Q3 Max   
## -2.69103507 -0.74924473 -0.03174829 0.75130421 2.69961967   
##   
## Residual standard error: 4.067002   
## Degrees of freedom: 617 total; 611 residual

### d. Write a few sentences reporting the results and their interpretation.