

## Question 2

Level 1 Model:

$$Y_{it} = a_i + b_i X_{it} + e_{it}$$

Level 2:

$$a_i = g_0 + g_1 z_i + u_i$$

$$b_i = h_0 + h_1 z_i + w_i$$

- $Y_{it}$  = Pain at time t for individual i
- $X_{it}$  = Time at time t for individual i
- $z_i$  are patient level factors (age, sex, race, income, retired status, use of NSAIDs)

Then

$$\begin{aligned} Y_{it} &= g_0 + g_1 z_i + u_i + (h_0 + h_1 z_i + w_i) * X_{it} + e_{it} \\ &= g_0 + g_1 z_i + h_0 X_{it} + h_1 z_i * X_{it} + u_i + w_i X_{it} + e_{it} \\ &= (g_0 + u_i) + g_1 z_i + (h_0 + w_i) X_{it} + h_1 z_i * X_{it} + e_{it} \end{aligned}$$

Can either fix Time and Temperature and check for significant Level 2 covariates

OR

Determine Level 1 model and then look at level 2 variables

Final model turns out to be

$$Pain_{it} = 7.8 + 0.8NSAID_i - 0.009Time_{it} - 0.02NSAID_i * Time_{it} + u_i + w_i Time_{it} + e_{it}$$

$$Var(u_i) = 9.69$$

$$Var(e_{it}) = 3.37$$

$$Var(w_i) = 0.001$$

i.e. has fixed effects of NSAID, Time and their interaction;

random effects of Time and intercept

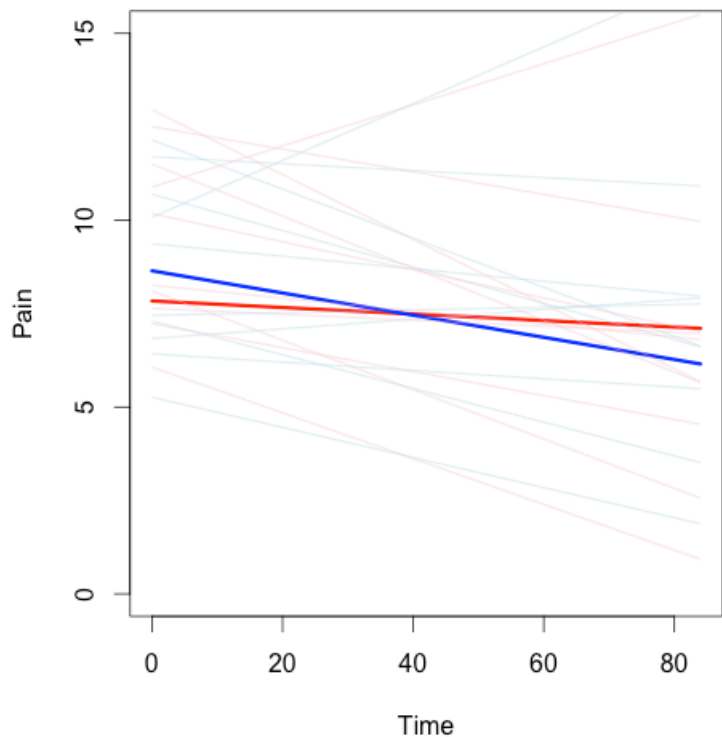
Fixed effects predictions

At time 0 with no NSAIDS,  $E(Pain_{i0}) = 7.8$

At time 0 with NSAIDS,  $E(Pain_{i0}) = 8.6$  i.e., those taking NSAIDS have more pain

At time 84 with no NSAIDS  $E(Pain_{i0}) = 7.1$

At time 84 with NSAIDS,  $E(Pain_{i0}) = 6.2$  i.e., those taking NSAIDS have less pain



Plot of Pain vs. time for NSAID (blue) and no NSAID (red). Average curves are thick, person curves are light.

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.688082	3.11257	
	time	0.001186	0.03444	-0.26
Residual		3.371959	1.83629	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	7.839032	0.538466	14.558
time	-0.008743	0.007158	-1.221
nsaid	0.807043	0.600331	1.344
time:nsaid	-0.020934	0.008025	-2.609

```
read.csv("/users/christopherschmid/desktop/McAlindon_Big.csv")
library(lme4)
library(nlme)
cols <- c("age", "race2", "inccat", "treat", "sex", "nsaid", "Occupation")
```

```

patID <- unique(data$ID)
paincol <- c(17, 19, 21, 23, 25, 27, 29)
timecol <- paincol + 1
datause <- matrix(NA,0,12)
# Set up database with pain and temperature measurements extracted on dates when
pain measured
for (i in 1:length(patID)) {
  id <- patID[i]
  tempdt <- data[data$ID==id, ]
  zi <- tempdt[1, c("ID", cols)]
  pain <- tempdt[1, paincol]
  pain <- pain[!is.na(pain)]
  time <- tempdt[1, timecol]
  temperature <- tempdt$avgtemp[tempdt$WeatherDate %in% time]
  time <- time[!is.na(time)]
  time <- time - time[1]
  datapti <- cbind(pain, time, temperature)
  datapti <- cbind(zi, datapti)
  datause <- rbind(datause, datapti)
}
datause$ID <- factor(datause$ID)
datause$inccat <- factor(datause$inccat)
female = datause$sex-1
white = datause$race2
table(datause$Occupation)
# Note varied occupations. Make new variable retired (yes/no)
xx = c(grep("tired",datause$Occupation),grep("TIRED",datause$Occupation))
yy = grep("never retired",datause$Occupation)
retired = rep(0,length(datause$Occupation))
retired[xx[-which(xx %in% yy)]] = 1
retired[datause$Occupation==""] = NA
datause = data.frame(datause,retired,female,white)
datause = datause[!is.na(datause$temperature),] # Remove missing days temperature
missing
model.0 = lmer(pain ~ 1|ID,REML = FALSE, data=datause) #Basic model with random
intercept
# Include time as a random effect
model.time = lmer(pain ~ time + (1+time|ID),REML = FALSE, data=datause)
# Include temperature as a random effect
model.temp = lmer(pain ~ temperature + (1+temperature|ID),REML = FALSE,
data=datause)
Warning messages:
1: In checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
  Model failed to converge with max|grad| = 0.00201622 (tol = 0.002, component 1)
2: In checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
  Model is nearly unidentifiable: very large eigenvalue
  - Rescale variables?
# Model does not converge, need to rescale
temp.scale = scale(datause$temperature) #Rescale temperature
age.scale = scale(datause$age) #Rescale age
datause = data.frame(datause,temp.scale,age.scale)
# Refit with scaled temperature
model.temp = lmer(pain ~ temp.scale + (1+temp.scale|ID),REML = FALSE,
data=datause)
# Model both temperature and time
model.both = lmer(pain ~ time + temp.scale + (1+time+temp.scale|ID),REML = FALSE,
data=datause)

```

### # Compare models. Time model best

```
anova(model.0,model.temp,model.time,model.both)
```

```
Data: datause
```

```
Models:
```

```
model.0: pain ~ 1 | ID
```

```
model.temp: pain ~ temp.scale + (1 + temp.scale | ID)
```

```
model.time: pain ~ time + (1 + time | ID)
```

```
model.both: pain ~ time + temp.scale + (1 + time + temp.scale | ID)
```

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	3	5494.4	5509.5	-2744.2	5488.4				
model.temp	6	5472.0	5502.1	-2730.0	5460.0	28.4115	3	2.977e-06	***
model.time	6	5290.4	5320.5	-2639.2	5278.4	181.6112	0	< 2.2e-16	***
model.both	10	5296.6	5346.8	-2638.3	5276.6	1.8133	4	0.7701	

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### # Loop over variables fitting Main Effect and Interaction models

```
vars = c("age.scale", "white", "inccat", "treat", "female", "nsaid", "retired")
```

```
for (i in 1:length(vars)) {
```

```
  code.0 <- paste('lmer(pain ~ time + (time|ID), REML=FALSE,data=datause, subset = !is.na(datause$',vars[i],'))', sep='')
```

```
  code.main <- paste('lmer(pain ~ time+', vars[i], ' + (time|ID), REML=FALSE,data=datause, subset = !is.na(datause$',vars[i],'))', sep = '')
```

```
  code.int <- paste('lmer(pain ~ time*', vars[i], ' + (time|ID), REML=FALSE,data=datause, subset = !is.na(datause$',vars[i],'))', sep = '')
```

```
  model.0 = eval(parse(text=code.0))
```

```
  model.main = eval(parse(text=code.main))
```

```
  model.int = eval(parse(text=code.int))
```

```
  print(summary(model.0))
```

```
  print(summary(model.main))
```

```
  print(summary(model.int))
```

```
  print(anova(model.0,model.main,model.int))
```

```
}
```

Linear mixed model fit by maximum likelihood ['lmerMod']

**Formula:** pain ~ time + (time | ID)

**Data:** datause

**Subset:** !is.na(datause\$age.scale)

AIC	BIC	logLik	deviance	df.resid
5290.4	5320.5	-2639.2	5278.4	1114

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.753944	3.12313	
	time	0.001251	0.03537	-0.27

Residual	3.374534	1.83699
----------	----------	---------

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.48673	0.23878	35.54
time	-0.02539	0.00329	-7.72

Correlation of Fixed Effects:

(Intr)  
time -0.388

**Formula: pain ~ time + age.scale + (time | ID)**

**Data: datause**

**Subset: !is.na(datause\$age.scale)**

AIC	BIC	logLik	deviance	df.resid
5290.2	5325.3	-2638.1	5276.2	1113

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.662858	3.10851	
	time	0.001249	0.03534	-0.27
Residual		3.374864	1.83708	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.486094	0.237849	35.68
time	-0.025385	0.003288	-7.72
age.scale	-0.326385	0.218361	-1.49

Correlation of Fixed Effects:

(Intr) time  
time -0.391  
age.scale 0.002 0.000

**Formula: pain ~ time \* age.scale + (time | ID)**

**Data: datause**

**Subset: !is.na(datause\$age.scale)**

AIC	BIC	logLik	deviance	df.resid
5292.1	5332.3	-2638.1	5276.1	1112

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.2239	-0.4825	0.0093	0.4679	3.4632

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.661216	3.10825	
	time	0.001247	0.03532	-0.27
Residual		3.375153	1.83716	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.4860489	0.2378331	35.68
time	-0.0253837	0.0032868	-7.72
age.scale	-0.3041251	0.2367127	-1.28
time:age.scale	-0.0008064	0.0033092	-0.24

Correlation of Fixed Effects:

(Intr) time ag.scl

```
time          -0.391
age.scale      0.002  0.001
time:ag.scl    0.001 -0.002 -0.386
```

**Data:** datause

**Subset:** !is.na(datause\$age.scale)

**Models:**

**model.0:** pain ~ time + (time | ID)

**model.main:** pain ~ time + age.scale + (time | ID)

**model.int:** pain ~ time \* age.scale + (time | ID)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	5290.4	5320.5	-2639.2	5278.4				
model.main	7	5290.2	5325.3	-2638.1	5276.2	2.2227		1	0.1360
model.int	8	5292.1	5332.3	-2638.1	5276.1	0.0593		1	0.8076

**# Age does not add to time**

**Formula:** pain ~ time + white + (time | ID)

**Data:** datause

**Subset:** !is.na(datause\$white)

	AIC	BIC	logLik	deviance	df.resid
	5291.0	5326.1	-2638.5	5277.0	1113

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.684070	3.11192	
	time	0.001248	0.03533	-0.27
Residual		3.375140	1.83716	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	7.753171	0.666569	11.631
time	-0.025399	0.003288	-7.725
white	0.824975	0.700127	1.178

Correlation of Fixed Effects:

	(Intr) time
time	-0.136
white	-0.934 -0.003

**Formula:** pain ~ time \* white + (time | ID)

**Data:** datause

**Subset:** !is.na(datause\$white)

	AIC	BIC	logLik	deviance	df.resid
	5293.0	5333.2	-2638.5	5277.0	1112

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.683368	3.11181	
	time	0.001248	0.03533	-0.27
Residual		3.375182	1.83717	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	7.7389083	0.7169520	10.794
time	-0.0248820	0.0101174	-2.459
white	0.8409585	0.7600765	1.106
time:white	-0.0005778	0.0106981	-0.054

Correlation of Fixed Effects:

	(Intr)	time	white
time	-0.389		
white	-0.943	0.367	
time:white	0.368	-0.946	-0.389

convergence code: 0

**Model failed to converge with max|grad| = 0.0023788 (tol = 0.002, component 1)**  
**Close enough**

**Data: datause**

**Subset: !is.na(datause\$white)**

**Models:**

**model.0: pain ~ time + (time | ID)**

**model.main: pain ~ time + white + (time | ID)**

**model.int: pain ~ time \* white + (time | ID)**

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	5290.4	5320.5	-2639.2	5278.4				
model.main	7	5291.0	5326.1	-2638.5	5277.0	1.3842		1	0.2394
model.int	8	5293.0	5333.2	-2638.5	5277.0	0.0029		1	0.9569

**# White not significant**

**Formula: pain ~ time + inccat + (time | ID)**

**Data: datause**

**Subset: !is.na(datause\$inccat)**

AIC	BIC	logLik	deviance	df.resid
2603.8	2646.8	-1291.9	2583.8	534

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	7.415611	2.72316	
	time	0.001124	0.03353	-0.28
Residual		3.852077	1.96267	

Number of obs: 544, groups: ID, 97

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.89902	0.73508	12.106
time	-0.02765	0.00470	-5.884
inccat2	-0.24795	0.86528	-0.287
inccat3	0.18785	0.90529	0.208
inccat4	-0.32789	1.13752	-0.288
inccat5	-1.46713	1.08130	-1.357

Correlation of Fixed Effects:

	(Intr)	time	incct2	incct3	incct4
time	-0.184				
inccat2	-0.820	-0.003			

```

inccat3 -0.784 -0.002 0.666
inccat4 -0.624 -0.002 0.530 0.507
inccat5 -0.656 -0.002 0.558 0.533 0.424

```

**Formula:** pain ~ time \* inccat + (time | ID)

**Data:** datause

**Subset:** !is.na(datause\$inccat)

AIC	BIC	logLik	deviance	df.resid
2607.9	2668.1	-1289.9	2579.9	530

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	7.33664	2.70862	
	time	0.00104	0.03225	-0.26
Residual		3.85341	1.96301	

Number of obs: 544, groups: ID, 97

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	9.1809791	0.7957794	11.537
time	-0.0373808	0.0116001	-3.222
inccat2	-0.8165160	0.9545497	-0.855
inccat3	0.2141924	0.9991323	0.214
inccat4	-0.6378580	1.2550236	-0.508
inccat5	-1.9548275	1.1979746	-1.632
time:inccat2	0.0195018	0.0139462	1.398
time:inccat3	-0.0008432	0.0146212	-0.058
time:inccat4	0.0106820	0.0182743	0.585
time:inccat5	0.0167561	0.0177978	0.941

Correlation of Fixed Effects:

	(Intr)	time	incct2	incct3	incct4	incct5	tm:nc2	tm:nc3	tm:nc4
time	-0.421								
inccat2	-0.834	0.351							
inccat3	-0.796	0.335	0.664						
inccat4	-0.634	0.267	0.529	0.505					
inccat5	-0.664	0.280	0.554	0.529	0.421				
time:incct2	0.350	-0.832	-0.424	-0.279	-0.222	-0.233			
time:incct3	0.334	-0.793	-0.278	-0.425	-0.212	-0.222	0.660		
time:incct4	0.267	-0.635	-0.223	-0.213	-0.424	-0.178	0.528	0.504	
time:incct5	0.274	-0.652	-0.229	-0.219	-0.174	-0.432	0.542	0.517	0.414

**Data:** datause

**Subset:** !is.na(datause\$inccat)

**Models:**

**model.0:** pain ~ time + (time | ID)

**model.main:** pain ~ time + inccat + (time | ID)

**model.int:** pain ~ time \* inccat + (time | ID)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	2598.7	2624.5	-1293.4	2586.7				
model.main	10	2603.8	2646.8	-1291.9	2583.8	2.9783		4	0.5615
model.int	14	2607.9	2668.1	-1289.9	2579.9	3.8983		4	0.4199

**Income not significant**

**Formula:** pain ~ time + treat + (time | ID)



**Data: datause**  
**Subset: !is.na(datause\$treat)**

AIC	BIC	logLik	deviance	df.resid
5292.3	5327.4	-2639.1	5278.3	1113

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.742862	3.12136	
	time	0.001251	0.03537	-0.27
Residual		3.374482	1.83698	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.54934	0.32171	26.575
time	-0.02538	0.00329	-7.715
treat	-0.12767	0.44009	-0.290

Correlation of Fixed Effects:

	(Intr)	time
time	-0.284	
treat	-0.671	-0.005

convergence code: 0  
Model failed to converge with max|grad| = 0.00212723 (tol = 0.002, component 1)

**Formula: pain ~ time \* treat + (time | ID)**  
**Data: datause**  
**Subset: !is.na(datause\$treat)**

AIC	BIC	logLik	deviance	df.resid
5293.8	5333.9	-2638.9	5277.8	1112

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.736230	3.12029	
	time	0.001243	0.03526	-0.26
Residual		3.374762	1.83705	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.614850	0.334083	25.787
time	-0.027745	0.004619	-6.007
treat	-0.261788	0.477292	-0.548
time:treat	0.004770	0.006568	0.726

Correlation of Fixed Effects:

	(Intr)	time	treat
time	-0.383		
treat	-0.700	0.268	
time:treat	0.270	-0.703	-0.386

**Data: datause**

Subset: !is.na(dataause\$treat)

Models:

model.0: pain ~ time + (time | ID)

model.main: pain ~ time + treat + (time | ID)

model.int: pain ~ time \* treat + (time | ID)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	5290.4	5320.5	-2639.2	5278.4				
model.main	7	5292.3	5327.4	-2639.2	5278.3	0.0840		1	0.7720
model.int	8	5293.8	5333.9	-2638.9	5277.8	0.5259		1	0.4683

Treatment not significant

Formula: pain ~ time + female + (time | ID)

Data: datause

Subset: !is.na(dataause\$female)

	AIC	BIC	logLik	deviance	df.resid
	5290.3	5325.5	-2638.2	5276.3	1113

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.676326	3.11068	
	time	0.001251	0.03537	-0.27
Residual		3.374344	1.83694	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.061550	0.378935	21.274
time	-0.025402	0.003289	-7.722
female	0.659949	0.457657	1.442

Correlation of Fixed Effects:

	(Intr)	time
time	-0.243	
female	-0.778	-0.004

Formula: pain ~ time \* female + (time | ID)

Data: datause

Subset: !is.na(dataause\$female)

	AIC	BIC	logLik	deviance	df.resid
	5292.2	5332.3	-2638.1	5276.2	1112

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.67858	3.11104	
	time	0.00125	0.03535	-0.27
Residual		3.37406	1.83686	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.107438	0.399040	20.317
time	-0.027042	0.005544	-4.878

female	0.588661	0.497151	1.184
time:female	0.002530	0.006886	0.367

# Correlation of Fixed Effects:

	(Intr)	time	female
time	-0.389		
female	-0.803	0.312	
time:female	0.313	-0.805	-0.390

## Data: datause

Subset: !is.na(datause\$female)

## Models:

model.0: pain ~ time + (time | ID)

model.main: pain ~ time + female + (time | ID)

model.int: pain ~ time \* female + (time | ID)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	5290.4	5320.5	-2639.2	5278.4				
model.main	7	5290.3	5325.5	-2638.2	5276.3	2.0684		1	0.1504
model.int	8	5292.2	5332.3	-2638.1	5276.2	0.1350		1	0.7133

Sex not significant

Formula: pain ~ time + nsaid + (time | ID)

## Data: datause

Subset: !is.na(datause\$nsaid)

	AIC	BIC	logLik	deviance	df.resid
	5292.2	5327.4	-2639.1	5278.2	1113

## Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.709218	3.11596	
	time	0.001251	0.03537	-0.26
Residual		3.374510	1.83698	

Number of obs: 1120, groups: ID, 205

## Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.31746	0.50588	16.442
time	-0.02539	0.00329	-7.715
nsaid	0.21039	0.55427	0.380

## Correlation of Fixed Effects:

	(Intr)	time
--	--------	------

time	-0.187
------	--------

nsaid	-0.882	0.006
-------	--------	-------

convergence code: 0

Model failed to converge with max|grad| = 0.00244417 (tol = 0.002, component 1)

Formula: pain ~ time \* nsaid + (time | ID)

## Data: datause

Subset: !is.na(datause\$nsaid)

	AIC	BIC	logLik	deviance	df.resid
	5287.5	5327.7	-2635.8	5271.5	1112

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.688082	3.11257	
	time	0.001186	0.03444	-0.26
Residual		3.371959	1.83629	

Number of obs: 1120, groups: ID, 205

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	7.839032	0.538466	14.558
time	-0.008743	0.007158	-1.221
nsaid	0.807043	0.600331	1.344
time:nsaid	-0.020934	0.008025	-2.609

Correlation of Fixed Effects:

	(Intr)	time	nsaid
time	-0.385		
nsaid	-0.897	0.345	
time:nsaid	0.344	-0.892	-0.385

Data: datause

Subset: !is.na(datause\$nsaid)

Models:

model.0: pain ~ time + (time | ID)

model.main: pain ~ time + nsaid + (time | ID)

model.int: pain ~ time \* nsaid + (time | ID)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	5290.4	5320.5	-2639.2	5278.4				
model.main	7	5292.2	5327.4	-2639.1	5278.2	0.1392		1	0.709035
model.int	8	5287.5	5327.7	-2635.8	5271.5	6.6973		1	0.009656 **

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

NSAID is significant

Formula: pain ~ time + (time | ID)

Data: datause

Subset: !is.na(datause\$retired)

AIC	BIC	logLik	deviance	df.resid
4139.8	4168.4	-2063.9	4127.8	868

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	9.019532	3.0033	
	time	0.001289	0.0359	-0.27
Residual		3.475382	1.8642	

Number of obs: 874, groups: ID, 158

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.606454	0.263475	32.67
time	-0.029439	0.003779	-7.79

Correlation of Fixed Effects:

	(Intr)
time	-0.397

**Formula: pain ~ time + retired + (time | ID)**

**Data: datause**

**Subset: !is.na(datause\$retired)**

AIC	BIC	logLik	deviance	df.resid
4141.3	4174.7	-2063.7	4127.3	867

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	8.985805	2.9976	
	time	0.001289	0.0359	-0.27
Residual		3.475287	1.8642	

Number of obs: 874, groups: ID, 158

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.46379	0.34007	24.888
time	-0.02945	0.00378	-7.791
retired	0.32177	0.48605	0.662

Correlation of Fixed Effects:

	(Intr) time
time	-0.304
retired	-0.634 -0.004

convergence code: 0

Model failed to converge with max|grad| = 0.00221396 (tol = 0.002, component 1)

**Formula: pain ~ time \* retired + (time | ID)**

**Data: datause**

**Subset: !is.na(datause\$retired)**

AIC	BIC	logLik	deviance	df.resid
4143.2	4181.4	-2063.6	4127.2	866

Random effects:

Groups	Name	Variance	Std.Dev.	Corr
ID	(Intercept)	8.985096	2.99751	
	time	0.001287	0.03588	-0.27
Residual		3.475328	1.86422	

Number of obs: 874, groups: ID, 158

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	8.435685	0.353220	23.882
time	-0.028422	0.005142	-5.527
retired	0.383478	0.529316	0.724
time:retired	-0.002232	0.007580	-0.294

Correlation of Fixed Effects:

	(Intr) time	retird
time	-0.398	
retired	-0.667 0.266	
time:retird	0.270 -0.678 -0.396	

```

Data: datause
Subset: !is.na(datause$retired)
Models:
model.0: pain ~ time + (time | ID)
model.main: pain ~ time + retired + (time | ID)
model.int: pain ~ time * retired + (time | ID)

```

	Df	AIC	BIC	logLik	deviance	Chisq	Chi	Df	Pr(Chisq)
model.0	6	4139.8	4168.4	-2063.9	4127.8				
model.main	7	4141.3	4174.7	-2063.7	4127.3	0.4375		1	0.5083
model.int	8	4143.2	4181.4	-2063.6	4127.2	0.0867		1	0.7684

Retired not significant

```

fixed.effects(finalmod) # fixed effects
random.effects(finalmod) #random effects
coef(finalmod) #person specific coefficients
x = seq(0,84, by=14)
coefs = fixed.effects(finalmod)
person.coefs = coef(finalmod)
plot(x,rep(0,7),type="n",ylim=c(0,15),xlab="Time",ylab="Pain")
nsaid0 = coefs[1]+x*coefs[2]
nsaid1 = coefs[1]+coefs[3]+x*(coefs[2]+coefs[4])
points(x, nsaid0, pch = "C", type="l",col="red",lwd=3)
points(x, nsaid1, pch = "T",type = "l",col="blue",lwd=3)
beta = person.coefs$ID
for (i in 1:10) {
  cont.pred = beta[i,1] + x*beta[i,2]
  tx.pred = beta[i,1]+beta[i,3]+x*(beta[i,2]+beta[i,4])
  points(x, cont.pred,type="l",col="lightblue",lwd=0.5)
  points(x, tx.pred,type="l",col="pink",lwd=0.5)
}

```