Formulating (G) lmer models

respiration (dichotomous) $Pr\{\text{"Good"}\}$
binomial link
epilepsy (count) seizure count
poisson link

Poisson mass $p(Y|\mu) = e^{-\mu}\frac{\mu^Y}{Y!}$ Link $\eta = g(\mu) = \log(\mu)$

Bernoulli mass $p(Y|\mu) = \mu^Y(1-\mu)^{1-Y}$

$\eta = g(\mu) = \log\left(\frac{\mu}{1-\mu}\right)$

Respiration ex class handout Sec 13.4 HSAUR

binomial link

Level 1 $\eta = \beta_0 + \varepsilon$ flat across months after protocol

flat trend by (1|subject) in lmer

Level 2

$\beta_0 = \gamma_{00} + \gamma_{01}$ baseline $+ \gamma_{02}$ month
$+ \gamma_{03}$ treatment $+ \gamma_{04}$ gender
$+ \gamma_{05}$ age $+ \gamma_{06}$ centre $+ u_0$

Combined model

substitute (Level 2 for β_0) to match lmer Rogosa R-session posting

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Alternative

Level 1 allows trend in logit over months

$\eta = \beta_0 + \beta_1 \times$ month $+ \varepsilon$ [do month − 1 so β_0 is meaningful

compare models

Respiratory Disorder (dichotomous)

STAT 222
week 5

```
> library(HSAUR2)        > data(respiratory)
> head(respiratory) #long form
    centre treatment gender age status month subject
1        1   placebo female  46   poor     0       1
112      1   placebo female  46   poor     1       1
223      1   placebo female  46   poor     2       1
334      1   placebo female  46   poor     3       1
445      1   placebo female  46   poor     4       1
2        1   placebo female  28   poor     0       2
> table(status, treatment,centre)
, , centre = 1
      treatment
status placebo treatment
  poor      93        67
  good      52        68

, , centre = 2
      treatment
status placebo treatment
  poor      65        31
  good      75       104
```

```
> table(gender, treatment)
        treatment
gender   placebo treatment
  female     200       240
  male        85        30
```

not 5 obs / person
tabulated
56 cent1, 55 cent2

```
> #Data manip from HSAUR #The baseline status, i.e., the status for month == 0, needs to
   enter the models as an explanatory variable (HSAUR)
> #rearrange the data.frame respiratory in order to create a new variable baseline
> resp <- subset(respiratory, month > "0")
> resp$baseline <- rep(subset(respiratory, month == "0")$status, rep(4, 111))
> resp$nstat <- as.numeric(resp$status == "good")
> #new variable nstat is simply a dummy coding for a poor respiratory status
> resp$month <- resp$month[, drop = TRUE]
```

```
# ignore individual trajectories, compare mean outcomes across groups
> resp_glm <- glm(status ~ centre + treatment + gender + baseline + age, data = resp,
     family = "binomial")
> summary(resp_glm)  # matches HSAUR
Coefficients:
                     Estimate Std. Error z value Pr(>|z|)
(Intercept)         -0.900171   0.337653  -2.666  0.00768 **
centre2              0.671601   0.239567   2.803  0.00506 **
treatmenttreatment   1.299216   0.236841   5.486 4.12e-08 ***
gendermale           0.119244   0.294671   0.405  0.68572
baselinegood         1.882029   0.241290   7.800 6.20e-15 ***
age                 -0.018166   0.008864  -2.049  0.04043 *
---
> exp(1.299)# odds 3.7 times higher of "good" for treat, not in love with adjusting initial status
[1] 3.665629
```

or use nstat

```
# now keep track of within-subject data with lmer (HSAUR does various gee also)
> resp_lmer <- lmer(status ~ baseline + month +  treatment + gender + age + centre
    + (1 | subject), family = binomial(), data = resp)
> summary(resp_lmer) # allowing individ mean levels to differ, no trend apparent
Generalized linear mixed model fit by the Laplace approximation
Formula: status ~ baseline + month + treatment + gender + age + centre + (1 | subject)
Random effects:
 Groups  Name        Variance Std.Dev.
 subject (Intercept) 3.9739   1.9935
Number of obs: 444, groups: subject, 111
Fixed effects:
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)         -1.66664    0.76708  -2.173   0.0298 *
baselinegood         3.10734    0.53246   5.836 5.35e-09 ***
month.L             -0.22795    0.27186  -0.838   0.4018
month.Q             -0.03890    0.27158  -0.143   0.8861
month.C             -0.36892    0.27269  -1.353   0.1761
treatmenttreatment   2.18393    0.52365   4.171 3.04e-05 ***
gendermale           0.20448    0.66883   0.306   0.7598
age                 -0.02566    0.02021  -1.269   0.2043
centre2              1.05614    0.53808   1.963   0.0497 *
---
> exp(fixef(resp_lmer))
   (Intercept)   baselinegood       month.L     month.Q     month.C treatmenttreatment
     0.1888801     22.3614175     0.7961675   0.9618516   0.6914812          8.8811669
    gendermale            age       centre2
     1.2268855      0.9746698     2.8752589
```

use nstat
same result

odds (good) 9x larger in treat