GLMM Short Course **Spring 2008**

LAB 4: GLMMs

The dataset ratlitter gives number of rat pups surviving (numsurv) at day 21 out of the number in the litter (littersize) at day 5 after birth. Each row of the dataset is a litter. Litters with treatment=1 were born to a mother fed a diet with a possibly toxic chemical. Those with treatment=0 are a control group.

1) Using NLMIXED, fit a logistic model with random effects for litter. Is there clustering by litter?
2) Does the treatment decrease the number surviving at day 21?
3) The treatment may also increase the variability from mom to mom. Use NLMIXED to write a model and test for a different litter-to-litter variance in the treatment group (as compared to the control group).

Recall the backpain dataset from Lab 3 with the following variables:

Doctor – Doctor ID number.
Cost – Cost of treatment in dollars.
Logcost – Logarithm of cost.
Actlim – Number of days in the past six months in which activity has been limited.
Undrstnd – Did the patient understand the doctor's advice (1=yes, 0=no)
Age – Age of the patient.
Educ – Education of the patient (0 means <12 years, 1 means 13-16 years, 2 means > 16 years education).
Thoraic – Whether the back pain was cervical/thoraic or other (1=yes, 0=no).
Pracstyl – Practice style of the doctor (0=low, 1=medium, 2=high frequency of prescription of medicines and hospitalization for treatment of back pain).

1) Analyze the response Undrstnd using SAS Proc NLMIXED.
   a) You will need to code dummy variables for Educ and Pracstyl.
   b) Fit a model with Age, Educ and Pracstyle as predictors
   c) Provide an interpretation of the coefficient for age.
2) How do the results differ from those in Lab 3? How does the interpretation of the age coefficient differ?
3) Repeat questions 1) and 2) using the outcome Actlim.

```
proc nlmixed data=work.ratlitter;
      parms mu=0 btrt=1 lns=-3;
      eta = mu+btrt*treatment+u;
      p = 1/(1+exp(-eta));
      model numsurv ~ binomial(littersize,p);
      random u ~ normal(0,exp(2*lns)) subject=litter;
run;
proc nlmixed data=work.ratlitter;
      parms mu=0 btrt=1 lns1=-3 lnratio=0.5;
      eta = mu+btrt*treatment+u;
      p = 1/(1+exp(-eta));
      model numsurv ~ binomial(littersize,p);
      random u ~ normal(0,exp(2*(lns1+lnratio*treatment)))
                 subject=litter;
run;
proc nlmixed data=work.backpain;
parms b0=0 bage=0 b1ed=0 b2ed=0 b1ps=0 b2ps=0 lnsig=-1;
eta=b0+bage*age+b1ed*ed1+b2ed*ed2+b1ps*ps1+b2ps*ps2+u;
p=1/(1+exp(-eta));
model undrstnd ~ binary(p);
random u~Normal(0,exp(lnsig)) subject=doctor;
run;
proc nlmixed data=work.backpain;
parms b0=0 bage=0 b1ed=0 b2ed=0 b1ps=0 b2ps=0 lnsig=-1;
eta=b0+bage*age+b1ed*ed1+b2ed*ed2+b1ps*ps1+b2ps*ps2+u;
lam=exp(eta);
model actlim ~ poisson(lam);
random u~Normal(0,exp(lnsig)) subject=doctor;
run;
```

```
library(MASS)
library(glmmML)
bpain<-read.table("backpain.txt", header=TRUE)
bpain<-bpain[order(bpain[,"Doctor"]),]
bpain$Educf<-factor(bpain$Educ)
#GLMM analyses for Understand
glmmML(Undrstnd ~ Age + Educf, family=binomial, data=bpain,
cluster=Doctor)
#PQL analysis for Understand
glmmPQL(Undrstnd ~ Age + Educf, family=binomial, data=bpain,
random=~1|Doctor)
#GEE analysis Activity limitation days
gee(Actlim ~ Age + Educf, family=poisson, data=bpain, id=Doctor,
corstr="exchangeable")
```