

Knee Data - Random Effects Logit Models

February 8, 2012

First the knee dataset is loaded:

```
> library(catdata)
> data(knee)
```

For the following models the data set is transformed into long format what can be done by the function "reshape".

In addition the dichotomized response variables "RD" is created. The groups are constructed by pain level up to level 2 und pain level higher than level 2.

```
> knee <- reshape(knee, direction="long", varying=list(5:8), v.names="R", timevar="Time")
> knee$RD <- rep(0, length(knee$R))
> knee$RD[knee$R>2] <- 1
```

For better interpretability the variable "Age" is centered around 30 , the variable "Age2" is created as quadratic effect of "Age".

```
> knee$Age <- knee$Age - 30
> knee$Age2 <- knee$Age^2
```

Since only the measurements 2, 3 and 4 are used for the models, measurement 1 can be eliminated.

```
> knee <- knee[knee$Time!=1,]
```

The first model will be fitted by Gauss–Hermite–Quadrature with 20 quadrature points by using function "glmmML" from library "glmmML".

```
> library(glmmML)
```

Now the random intercept model with Gauss–Hermite–Quadrature is fitted, the option "method" has to be set on "ghq", the number of quadrature points is set by "n.points".

```
> kneeGHQ <- glmmML(RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2, data=knee,
+ family=binomial(), method="ghq", n.points=20, cluster=id)
> summary(kneeGHQ)
```

```
Call: glmmML(formula = RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2, family = bi
```

	coef	se(coef)	z	Pr(> z)
(Intercept)	3.0540	1.10110	2.774	0.0055
as.factor(Th)2	-1.8618	0.84628	-2.200	0.0280
as.factor(Sex)1	0.6071	0.88732	0.684	0.4900
Age	0.0324	0.04392	0.739	0.4600
Age2	-0.0155	0.00531	-2.922	0.0035

Scale parameter in mixing distribution: 3.62 gaussian
Std. Error: 0.633

LR p-value for H₀: sigma = 0: 1.51e-24

Residual deviance: 375 on 375 degrees of freedom AIC: 387

The random intercept model with Penalized Quasi-Likelihood is fitted by use of "glmmPQL" from the library "MASS".

```
> kneePQL <- glmmPQL(RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2, data=knee,
+ random = ~ 1|id, family=binomial())
> summary(kneePQL)
```

Linear mixed-effects model fit by maximum likelihood

Data: knee
AIC BIC logLik
NA NA NA

Random effects:

Formula: ~1 | id
(Intercept) Residual
StdDev: 2.71 0.632

Variance function:

Structure: fixed weights
Formula: ~invwt

Fixed effects: RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2

	Value	Std.Error	DF	t-value	p-value
(Intercept)	2.143	0.715	254	3.00	0.0030
as.factor(Th)2	-1.295	0.564	122	-2.29	0.0235
as.factor(Sex)1	0.414	0.622	122	0.67	0.5062
Age	0.023	0.031	122	0.73	0.4639
Age2	-0.011	0.003	122	-3.17	0.0019

Correlation:

	(Intr)	a.(T)2	a.(S)1	Age
as.factor(Th)2	-0.451			
as.factor(Sex)1	-0.673	0.046		
Age	0.085	0.104	0.086	
Age2	-0.526	0.006	0.091	-0.330

Standardized Within-Group Residuals:

Min	Q1	Med	Q3	Max
-2.357	-0.395	0.266	0.353	2.240

Number of Observations: 381
Number of Groups: 127

The library "gee" is needed for fitting of the marginal model.

```
> library(gee)
```

For the marginal model the data set has to be arranged according to the variable "id" so that measurements from the same individual are arranged one after the other.

```
> knee <- knee[order(knee$id),]  
> kneeGEE <- gee(RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2, data=knee,  
+ family=binomial(), id=id, corstr="exchangeable")
```

(Intercept)	as.factor(Th)2	as.factor(Sex)1	Age	Age2
1.17278	-0.67398	0.26569	0.01369	-0.00612

```
> summary(kneeGEE)
```

GEE: GENERALIZED LINEAR MODELS FOR DEPENDENT DATA
gee S-function, version 4.13 modified 98/01/27 (1998)

Model:

Link: Logit
Variance to Mean Relation: Binomial
Correlation Structure: Exchangeable

Call:

```
gee(formula = RD ~ as.factor(Th) + as.factor(Sex) + Age + Age2,  
id = id, data = knee, family = binomial(), corstr = "exchangeable")
```

Summary of Residuals:

Min	1Q	Median	3Q	Max
-0.809	-0.477	0.239	0.388	0.766

Coefficients:

	Estimate	Naive S.E.	Naive z	Robust S.E.	Robust z
(Intercept)	1.17278	0.42386	2.767	0.44806	2.617
as.factor(Th)2	-0.67398	0.33316	-2.023	0.33421	-2.017
as.factor(Sex)1	0.26569	0.36012	0.738	0.36673	0.724
Age	0.01369	0.01792	0.764	0.01736	0.789
Age2	-0.00612	0.00206	-2.978	0.00198	-3.086

Estimated Scale Parameter: 1.02

Number of Iterations: 1

Working Correlation

[,1]	[,2]	[,3]
------	------	------

```
[1,] 1.000 0.608 0.608  
[2,] 0.608 1.000 0.608  
[3,] 0.608 0.608 1.000
```