Knee Injuries - Marginal Models

November 1, 2024

First the dataset knee is loaded:

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

To obtain a simple binary model the response variables are dichotomized. The groups are constructed by pain level up to level 2 und pain level higher than level 2.

```
> R2D <- rep(0, length(R2))
> R3D <- rep(0, length(R3))
> R4D <- rep(0, length(R3))
> R2D[R2>2] <- 1
> R3D[R3>2] <- 1
> R4D[R4>2] <- 1
```

Now the covariates have to be transformed so that they can be used for the functions "gee" from the "gee"–library and "geeglm" from the "geepack"–library, which will be employed for fitting the models.

```
> N <- rep(knee$N, each=3)
> Th <- rep(knee$Th, each=3)
> Age <- rep(knee$Age, each=3)
> Sex <- rep(knee$Sex, each=3)
```

Now the response vector is built and the quadratic age–effect "Age2" is computed.

```
> Response <- c(rbind(R2D,R3D,R4D))
> Age2 <- Age^2
```

The covariates therapy and sex are treated as factors:

```
> Th <- as.factor(Th)
> Sex <- as.factor(Sex)
```

First the GEEs are fitted with the funtion "gee" from library "gee".

```
> library(gee)
```

The first model is a GEE with independent correlation structure:

```
> gee1a <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit))

> summary(gee1a)
```

The second model is a GEE with exchangeable correlation structure:

```
> gee2a <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="exchangeable")

> summary(gee2a)
```

Finally a GEE with exponential correlation structure is fitted:

```
> gee3a <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="AR-M", Mv=1)

> summary(gee3a)
```

In the following the corresponding marginal models are fitted with the function "geeglm" from the library "geepack".

```
> library(geepack)
```

Model with independent correlation structure:

```
> gee1b <- geeglm(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit))

> summary(gee1b)
```

Model with exchangeable correlation structure:

```
> gee2b <- geeglm(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="exchangeable")

> summary(gee2b)
```

Model with exponential correlation structure:

```
> gee3b <- geeglm(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="ar1")

> summary(gee3b)
```

For comparison a simple GLM with logit–link is fitted with the same covariates as in the marginal models above:

```
> glm1 <- glm(Response ~ Th + Sex + Age + Age2,
+ family=binomial(link=logit))
> summary(glm1)
```

It is often advatageous to center the variables like age around a value in the middle of its range. So now the marginal models from above are replicated with age centered around 30 years.

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

Again we use the function "gee" from the "gee"–library for fitting those models.

Model with independent correlation structure and centered age:

```
> gee1c <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit))

> summary(gee1c)
```

Model with exchangeable correlation structure and centered age:

```
> gee2c <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="exchangeable")

> summary(gee2c)
```

Model with exponential correlation structure and centered age:

```
> gee3c <- gee(Response ~ Th + Sex + Age + Age2, id=N,
+ family=binomial(link=logit), corstr="AR-M", Mv=1)

> summary(gee3c)
```