# Birth Data - Bivariate Binary GEE

November 1, 2024

The Birth data are loaded.

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

The original variable "Intensive" is converted into the binary variable "Intensive" indicating whether the child spent time in intensive care or not. In addition, "Previous" is reduced to 3 categories by merging two and more previous pregnancies to level "2".

```
> intensive <- rep(0,length(Intensive))
> intensive[Intensive>0] <- 1
> Intensive <- intensive
> previous <- Previous
> previous[previous>1] <- 2
> Previous <- previous
```

For the GEE the package "gee" will be used.

```
> library(gee)
```

For comparison again the binary regression model "bivarlogit" including odds ratios is fitted

```
> library(VGAM)
> Birth <- as.data.frame(na.omit(cbind(Intensive, Cesarean, Sex, Weight, Previous,
+ AgeMother)))
> detach(birth)
> bivarlogit <- vglm(cbind(Intensive , Cesarean) ~ Weight + AgeMother +
+ as.factor(Sex) + as.factor(Previous), binom2.or(zero=NULL), data=Birth)
> summary(bivarlogit)
```

To fit the bivariate GEE the covariates have to be created separately for both response variables.

```
> n <- dim(Birth)[1]
> ID <- rep(1:n,2)
> InterceptInt <- InterceptCes <- rep(1, 2*n)
> InterceptInt[(n+1):(2*n)] <- InterceptCes[1:n] <- 0
> AgeMotherInt <- AgeMotherCes <- rep(Birth$AgeMother,2)
```

```
> AgeMotherInt[(n+1):(2*n)] <- AgeMotherCes[1:n] <- 0
> SexInt <- SexCes <- rep(Birth$Sex,2)
> SexInt[SexInt==1] <- SexCes[SexCes==1] <- 0
> SexInt[SexInt==2] <- SexCes[SexCes==2] <- 1
> SexInt[(n+1):(2*n)] <- SexCes[1:n] <- 0
> PrevBase <- rep(Birth$Previous,2)
> PreviousInt1 <- PreviousCes1 <- PreviousInt2 <- PreviousCes2 <- rep(0, 2*n)
> PreviousInt1[PrevBase==1] <- PreviousCes1[PrevBase==1] <- 1
> PreviousInt2[PrevBase>=2] <- PreviousCes2[PrevBase>=2] <- 1
> PreviousInt1[(n+1):(2*n)] <- PreviousInt2[(n+1):(2*n)] <- PreviousCes1[1:n] <-
+   PreviousCes2[1:n] <- 0
> WeightInt <- WeightCes <- rep(Birth$Weight,2)
> WeightInt[(n+1):(2*n)] <- WeightCes[1:n] <- 0
```

The created covariates are collected in the data set "GeeDat" that will be used for the GEE.

```
> GeeDat <- as.data.frame(cbind(ID, InterceptInt, InterceptCes, SexInt , SexCes ,
+ WeightInt , WeightCes , PreviousInt1 , PreviousInt2, PreviousCes1,
+ PreviousCes2, AgeMotherInt , AgeMotherCes, Response=
+ c(Birth$Intensive, Birth$Cesarean)))
```

Finally the GEE is fitted.

```
> gee1 <- gee (Response ~ -1 + InterceptInt + InterceptCes + WeightInt + WeightCes
+              + AgeMotherInt + AgeMotherCes + SexInt + SexCes +
+ PreviousInt1 + PreviousCes1 + PreviousInt2 + PreviousCes2,
+ family=binomial(link=logit), id=ID, data=GeeDat)
> summary(gee1)
```

Here the respective coefficients from the bivariate regression model and from the GEE can be compared.

```
> coefficients(bivarlogit)[1:2]
> coefficients(gee1)[1:2]
> coefficients(bivarlogit)[4:5]
> coefficients(gee1)[3:4]
> coefficients(bivarlogit)[7:8]
> coefficients(gee1)[5:6]
> coefficients(bivarlogit)[10:11]
> coefficients(gee1)[7:8]
> coefficients(bivarlogit)[13:14]
> coefficients(gee1)[9:10]
> coefficients(bivarlogit)[16:17]
> coefficients(gee1)[11:12]
```