

# Birth Data - Bivariate Binary GEE

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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]
```