```r
rm(list=ls());gc()

# Required R packages
library(rms)
library(foreign)
library(glmnet)
library(numDeriv)



#******************####
# (I) Main Analysis ####
#******************####

# Prespecified risk factors for generating design matrix
XX <- Cs(SUPINFEC,WNDINFD,ORGSPCSSI,DEHIS,OUPNEUMO,REINTUB,
         FAILWEAN,RENAINSF,OPRENAFL,URNINFEC,CNSCVA,CDARREST,CDMI,
         # OTHBLEED,VTE, # exclude from variable selection
         OTHSYSEP,OTHSESHOCK,  # Postop complications

         AGE,SEX,RACE2,HEIGHT,WEIGHT,
         WORKRVU,INOUT,TRANST2,ANESTHES2,SURGSPEC2,EMERGNCY,WNDCLAS,ASACLAS2,Class,
         DIABETES,SMOKE,DYSPNEA,FNSTATUS2.f,VENTILAT,HXCOPD,
         ASCITES,HXCHF,HYPERMED,RENAFAIL,DIALYSIS,DISCANCR,
         WNDINF,STEROID,WTLOSS,TRANSFUS,PRSEPIS,OPTIME,TOTHLOS,
         HTOODAY,RETURNOR,                  # Demos, Operations,Comobidities

         PRSODM0, PRBUN0, PRCREAT0, PRALBUM0, PRBILI0, PRSGOT0,
         PRALKPH0, PRWBC0, PRHCT0, PRPLATE0, PRPTT0, PRINR0, PRPT0,
         PRSODM.i,PRBUN.i,PRCREAT.i,PRALBUM.i,PRBILI.i,PRSGOT.i,
         PRALKPH.i,PRWBC.i,PRHCT.i,PRPLATE.i,PRPTT.i,PRINR.i,PRPT.i) # Labs

# Primary Analysis: all patients ###

# load cleaned data for regression
load('AM_Cleaned_Data2020.Rdata')

## 1. Year 2006 LASSO ####
# Relaxed LASSO for year 2005-2006 data

# Design matrix for LASSO
dat <- na.omit(dat06[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')]) # glmnet does not accept missing data
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data = dat)
Y <- dat$DEATH

# Step 1: variable selection using LASSO
Sys.time()
lasso.06 <- glmnet(X, Y, family = "binomial", alpha = 1) # alpha=1: LASSO
Sys.time()

plot(lasso.06)
vn <- colnames(X)
vnat06 <- coef(lasso.06)
vnat06 <- vnat06[-1, ncol(vnat06)] # remove the intercept, and get the coefficients at the end of the path
axis(4, at=vnat06, line=-.5, label=vn, las=1, tick=FALSE, cex.axis=0.8)

# Crossvalidation: cross-validated Lasso penalty parameter - lambda
Sys.time()
set.seed(123)
cv.06 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()

summary(cv.06)
plot(cv.06)  # top axis is number of variables in model
cbind(coef(cv.06, s="lambda.min"), coef(cv.06, s="lambda.1se"))

plot(lasso.06, label=TRUE, xvar="lambda")
abline(v=log(cv.06$lambda.min), lty=2, lwd=0.5)
abline(v=log(cv.06$lambda.1se), lty=2, lwd=0.5)

# Pick 'best' cross-validated lambda using 1 SE criteria
coef(lasso.06, s=log(cv.06$lambda.1se))
cv.06$lambda.1se

# Relaxed Lasso
b <- coef(cv.06, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]    # lasso CV picked variables
dropped <- setdiff(colnames(X), subset) # lasso CV dropped variables
```

```
# Step 2: Rerun logistic regression using the selected variables

# index for age, weight
(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))

# revised design matrix that incoporates nonlinear effect of age and weight,
# and force VTE and OTHBLEED in the model
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )

Xi <- Xi[,-1]
fit.06  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.06)

save(lasso.06, cv.06, X, fit.06, subset, dropped, file='ModelResults_Y06.Rdata')


# We repeat the two steps (select and refit) procedure for each year

## 2. Year 2007 LASSO ####
dat <- na.omit(dat07[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.07 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.07 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.07)

# Relaxed Lasso
b <- coef(cv.07, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )

Xi <- Xi[,-1]
fit.07  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.07)

save(lasso.07, cv.07, X, fit.07, subset, dropped, file='ModelResults_Y07.Rdata')


## 3. Year 2008 LASSO ####
dat <- na.omit(dat08[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.08 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.08 <- cv.glmnet(X, Y, family = "binomial")
summary(cv.08)

# Relaxed Lasso
b <- coef(cv.08, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))

Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]
fit.08  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.08)

save(lasso.08, cv.08, X, fit.08, subset, dropped, file='ModelResults_Y08.Rdata')
```

```
## 4. Year 2009 LASSO ####
dat <- na.omit(dat09[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.09 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.09 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.09)

b <- coef(cv.09, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1] # lasso cv picked x variables
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )

Xi <- Xi[,-1]
fit.09  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.09)

save(lasso.09, cv.09, X, fit.09, subset, dropped, file='ModelResults_Y09.Rdata')


## 5. Year 2010 LASSO ####
dat <- na.omit(dat10[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.10 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.10 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.10)

# Relaxed Lasso
b <- coef(cv.10, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]
fit.10  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.10)

save(lasso.10, cv.10, X, fit.10, subset, dropped, file='ModelResults_Y10.Rdata')


## 6. Year 2011 LASSO ####
dat <- na.omit(dat11[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.11 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.11 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.11)

# Relaxed Lasso
b <- coef(cv.11, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
```

```
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]

fit.11  <- glm(Y ~ Xi, family=binomial(link="logit"))
print(fit.11)

save(lasso.11, cv.11, X, fit.11, subset, dropped, file='ModelResults_Y11.Rdata')


## 7. Year 2012 LASSO ####
dat <- na.omit(dat12[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.12 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.12 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.12)

# Relaxed Lasso
b <- coef(cv.12, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1];colnames(Xi);

fit.12  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.12)

save(lasso.12, cv.12, X, fit.12, subset, dropped, file='ModelResults_Y12.Rdata')


## 8. Year 2013 LASSO ####
dat <- na.omit(dat13[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.13 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.13 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.13)

# Relaxed Lasso
b <- coef(cv.13, s="lambda.1se") # lambda.min
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1] # lasso cv picked x variables
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1];colnames(Xi);

fit.13  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.13)

save(lasso.13, cv.13, X, fit.13, subset, dropped, file='ModelResults_Y13.Rdata')


## 9. Year 2014 LASSO ####
dat <- na.omit(dat14[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH
```

```
lasso.14 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.14 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.14)

# Relaxed Lasso
b <- coef(cv.14, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]; colnames(Xi);

fit.14  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.14)

save(lasso.14, cv.14, X, fit.14, subset, dropped, file='ModelResults_Y14.Rdata')


## 10. Year 2015 LASSO ####
dat <- na.omit(dat15[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.15 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.15 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.15)

# Relaxed Lasso
b <- coef(cv.15, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]; colnames(Xi);

fit.15  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.15)

save(lasso.15, cv.15, X, fit.15, subset, dropped,  file='ModelResults_Y15.Rdata')


## 11. Year 2016 LASSO ####
dat <- na.omit(dat16[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.16 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.16 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.16)

# Relaxed Lasso
b <- coef(cv.16, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
```

```
Xi <- Xi[,-1]; colnames(Xi);

fit.16  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.16)

save(lasso.16, cv.16, X, XX, fit.16, subset, dropped, file='ModelResults_Y16.Rdata')


## 12. Year 2017 LASSO ####
dat <- na.omit(dat17[, c(XX, 'OTHBLEED', 'VTE', 'DEATH')])
XX[c(65,78)]
XX <- XX[-c(65,78)] # Remove PRPT: PRPT not available in 2017 dataset
form <- as.formula(paste(" ~ ", paste0(XX, collapse = " + ")))
X <- model.matrix(form, data=dat)
Y <- dat$DEATH

lasso.17 <- glmnet(X, Y, family = "binomial")

# Crossvalidation: Lasso
Sys.time()
cv.17 <- cv.glmnet(X, Y, family = "binomial")
Sys.time()
summary(cv.17)

# Relaxed Lasso
b <- coef(cv.17, s="lambda.1se")
colnames(b) <- "lasso.1se"
subset <- colnames(X)[which(b!=0)-1]
dropped <- setdiff(colnames(X), subset)

(IND <- c(grep('AGE', subset),grep('WEIGHT', subset)))
Xi <- cbind( model.matrix( as.formula( '~ OTHBLEED + VTE + rcs(AGE,5) + rcs(WEIGHT,5)' ) , data=dat),
             X[, subset[-IND]] )
Xi <- Xi[,-1]; colnames(Xi);

fit.17  <- glm(Y ~ Xi, family=binomial(link="logit"))
summary(fit.17)

save(lasso.17, cv.17, X, XX, fit.17, subset, dropped, file='ModelResults_Y17.Rdata')


# Function for odds ratio
OR.cal <- function(obj=fit.06, YEAR='Year 2006') {

  ii <- c(grep('OTHBLEED', names(obj$coef)), grep('VTE', names(obj$coef)))
  COEF <- obj$coef[ii]
  se <- sqrt(diag(summary(obj)$cov.unscaled[ii, ii]))

  LOWCI <- UPPCI <- PVAL <- NULL
  COL.NAME <- gsub('Xi', '', names(beta))
  ROW.NAME <- YEAR

  LOWCI <- COEF - 1.96*se
  UPPCI <- COEF + 1.96*se
  PVAL <- 2*pnorm( abs(COEF/se), lower.tail=F)
  PVAL0 <- ifelse(PVAL < 0.001, '< 0.001',
                  ifelse(PVAL<0.01, format(round(PVAL,3),nsmall=3), format(round(PVAL,2),nsmall=2)))

  # Adj.OR <- exp(COEF)
  Adj.OR <- paste0(round(exp(COEF),2), ' (', round(exp(LOWCI),2), ', ', round(exp(UPPCI),2), '), ', PVAL0)
  Adj.OR <- matrix(Adj.OR, nrow=1, ncol=2, byrow=T)
  colnames(Adj.OR) <- COL.NAME
  rownames(Adj.OR) <- ROW.NAME

  OR <- exp(COEF)
  LOW <- exp(LOWCI)
  UPP <- exp(UPPCI)

  return(list(Adj.OR=Adj.OR, OR=OR, LOW=LOW, UPP=UPP, PVAL=PVAL0, Beta=COEF, SE=se))
}

# Function calculating attributable mortality
# a: number of complications
# b: number of no complications
# c: number of deaths
# p.c: proportion of death among those with complications
# p.nc: proportion of death among those with no complications
a.mort.cal <- function(a=150, b=850, c=110, OR=1.8, p.c=0.053, p.nc=0.013) {

  a0 <- b*OR-b
```

```
  b0 <- a*OR-c*OR+b+c
  c0 <- -c

  y <- (-b0 + sqrt( b0^2 -4*a0*c0))/(2*a0)
  x <- (c-b*y)/a
  af.adj <- x-y
  af.unadj <- p.c - p.nc
  AM.adj   <- a*(x-y)
  AM.unadj <- a*(p.c - p.nc)

  N <- a+b
  comp.perc  <- a/N
  death.perc <- c/N

  return(list(AM.adj=AM.adj, AM.unadj=AM.unadj,
             af.adj=af.adj, af.unadj=af.unadj,
             x=x, y=y,
             N=N, comp.perc=comp.perc, death.perc=death.perc))
}


# Calculate Odds Ratio and Attributable Mortality ####

# Year 2006 AM.OR ####
dat <-  dat06; YEAR <- '2006'
COMP <- c("OTHBLEED","VTE")

load('ModelResults_Y06.Rdata')

OR   <- OR.cal(obj=fit.06, YEAR='Year 2006')$OR
Beta <- OR.cal(obj=fit.06, YEAR='Year 2006')$Beta
SE   <- OR.cal(obj=fit.06, YEAR='Year 2006')$SE
PVAL <- OR.cal(obj=fit.06, YEAR='Year 2006')$PVAL
OR.LOW <- OR.cal(obj=fit.06, YEAR='Year 2006')$LOW
OR.UPP <- OR.cal(obj=fit.06, YEAR='Year 2006')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.06 <- b.06 <- c.06 <- p.c.06 <- p.nc.06 <- Comp.Rate.06 <- Adj.AM.06 <- Unadj.AM.06 <- matrix(NA, nrow=1, ncol=2)
N.06 <- comp.perc.06 <- death.perc.06 <- x.06 <- y.06 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.06[, COMP[i] ] <- sum( dat[, COMP[i]] != 'NoComplication', na.rm = T)  # Complication
  b.06[, COMP[i] ] <- sum( dat[, COMP[i]] == 'NoComplication', na.rm = T)  # No Complication
  c.06[, COMP[i] ] <- sum( dat[, 'DEATH'] == 1, na.rm = T)                 # Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH', COMP[i])]
  p.c.06[, COMP[i] ]  <- mean(bla$DEATH == 1, na.rm = T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH', COMP[i])]
  p.nc.06[, COMP[i] ] <- mean(bla$DEATH == 1, na.rm = T)
  Comp.Rate.06[, COMP[i] ] <- mean(dat[[ COMP[i] ]] != 'NoComplication', na.rm = T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a = a.06[1, j], b = b.06[1, j], c = c.06[1, j], OR = OR[j], p.c = p.c.06[1, j], p.nc = p.nc.06[1,
j])
  Adj.AM.06[1, j]   <- lala$AM.adj
  Unadj.AM.06[1, j] <- lala$AM.unadj
  x.06[1, j]        <- lala$x
  y.06[1, j]        <- lala$y
  N.06[1, j]        <- lala$N
  comp.perc.06[1, j]  <- lala$comp.perc
  death.perc.06[1, j] <- lala$death.perc
}

# Delta method for 95% CI of attributable mortality
# AM function feed to grad() to calculate 1st derivative
g.06.bleed <- function(x) {
  a0 <- 151358*exp(x)-151358
  b0 <- 929*exp(x)-2707*exp(x)+151358+2707
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-2707)))/(2*a0)
  x0 <- (2707-151358*y0)/929
  929*(x0-y0)
}
g.06.bleed(x=Beta[1] )
(g.prim <- grad(func=g.06.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.06.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.06[1,1] + c(-1, 1)*1.96*AM.se) # CI using delta method

g.06.thromb <- function(x=Beta[j] ) {
```

```
  a0 <- 150812*exp(x)-150812
  b0 <- 1475*exp(x)-2707*exp(x)+150812+2707
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-2707)))/(2*a0)
  x0 <- (2707-150812*y0)/1475
  1475*(x0-y0)
}
g.06.thromb(x=Beta[2])
(g.prim <- grad(func=g.06.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.06.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.06[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.06 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.06[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.06[1,1], Y=y.06[1,1], N=N.06[1,1], comp.perc=comp.perc.06[1,1], death.perc=death.perc.06[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.06[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.06[1,2], Y=y.06[1,2], N=N.06[1,2], comp.perc=comp.perc.06[1,2], death.perc=death.perc.06[1,2]))
)
rownames(OUTPUT.06) <- NULL
OUTPUT.06$YEAR <- 2006
OUTPUT.ALL <- rbind(OUTPUT.06)


# Year 2007 AM.OR ####
load('ModelResults_Y07.Rdata')

dat <-  dat07; YEAR <- '2007'
COMP <- c("OTHBLEED","VTE")

## Adjusted OR
OR   <- OR.cal(obj=fit.07, YEAR='Year 2007')$OR
Beta <- OR.cal(obj=fit.07, YEAR='Year 2007')$Beta
SE   <- OR.cal(obj=fit.07, YEAR='Year 2007')$SE
PVAL <- OR.cal(obj=fit.07, YEAR='Year 2007')$PVAL
OR.LOW <- OR.cal(obj=fit.07, YEAR='Year 2007')$LOW
OR.UPP <- OR.cal(obj=fit.07, YEAR='Year 2007')$UPP

a.07 <- b.07 <- c.07 <- p.c.07 <- p.nc.07 <- Comp.Rate.07 <- Adj.AM.07 <- Unadj.AM.07 <- matrix(NA, nrow=1, ncol=2)
N.07 <- comp.perc.07 <- death.perc.07 <- x.07 <- y.07 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.07[, COMP[i] ] <- sum( dat[, COMP[i]] != 'NoComplication', na.rm = T)  # Complication
  b.07[, COMP[i] ] <- sum( dat[, COMP[i]] == 'NoComplication', na.rm = T)  # No Complication
  c.07[, COMP[i] ] <- sum( dat[, 'DEATH'] == 1, na.rm = T)                 # Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH', COMP[i])]
  p.c.07[, COMP[i] ]  <- mean(bla$DEATH == 1, na.rm = T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH', COMP[i])]
  p.nc.07[, COMP[i] ] <- mean(bla$DEATH == 1, na.rm = T)
  Comp.Rate.07[, COMP[i] ] <- mean(dat[[ COMP[i] ]] != 'NoComplication', na.rm = T)
}


for (j in 1:2) {

  lala <- a.mort.cal(a = a.07[1, j], b = b.07[1, j], c = c.07[1, j], OR = OR[j], p.c = p.c.07[1, j], p.nc = p.nc.07[1,
j])
  Adj.AM.07[1, j]   <- lala$AM.adj
  Unadj.AM.07[1, j] <- lala$AM.unadj
  x.07[1, j]        <- lala$x
  y.07[1, j]        <- lala$y
  N.07[1, j]        <- lala$N
  comp.perc.07[1, j]  <- lala$comp.perc
  death.perc.07[1, j] <- lala$death.perc
}

g.07.bleed <- function(x) {
  a0 <- 210305*exp(x)-210305
  b0 <- 1044*exp(x)-3683*exp(x)+210305+3683
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-3683)))/(2*a0)
  x0 <- (3683-210305*y0)/1044
  1044*(x0-y0)
}
g.07.bleed(x=Beta[1] )
(g.prim <- grad(func=g.07.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.07.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.07[1,1] + c(-1, 1)*1.96*AM.se)
```

```
g.07.thromb <- function(x=Beta[j] ) {
  a0 <- 209328*exp(x)-209328
  b0 <- 2021*exp(x)-3683*exp(x)+209328+3683
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-3683)))/(2*a0)
  x0 <- (3683-209328*y0)/2021
  2021*(x0-y0)
}

g.07.thromb(x=Beta[2])
(g.prim <- grad(func=g.07.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.07.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.07[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.07 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.07[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.07[1,1], Y=y.07[1,1], N=N.07[1,1], comp.perc=comp.perc.07[1,1], death.perc=death.perc.07[1,1]),
  data.frame(Comp='VTE', AM=Adj.AM.07[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.07[1,2], Y=y.07[1,2], N=N.07[1,2], comp.perc=comp.perc.07[1,2], death.perc=death.perc.07[1,2]))
)

rownames(OUTPUT.07) <- NULL
OUTPUT.07$YEAR <- 2007
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.07)

# Year 2008 AM.OR ####
load('ModelResults_Y08.Rdata')

dat <-  dat08; YEAR <- '2008'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.08, YEAR='Year 2008')$OR
Beta <- OR.cal(obj=fit.08, YEAR='Year 2008')$Beta
SE   <- OR.cal(obj=fit.08, YEAR='Year 2008')$SE
PVAL <- OR.cal(obj=fit.08, YEAR='Year 2008')$PVAL
OR.LOW <- OR.cal(obj=fit.08, YEAR='Year 2008')$LOW
OR.UPP <- OR.cal(obj=fit.08, YEAR='Year 2008')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.08 <- b.08 <- c.08 <- p.c.08 <- p.nc.08 <- Comp.Rate.08 <- Adj.AM.08 <- Unadj.AM.08 <- matrix(NA, nrow=1, ncol=2)
N.08 <- comp.perc.08 <- death.perc.08 <- x.08 <- y.08 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.08[, COMP[i] ] <- sum( dat[, COMP[i]] != 'NoComplication', na.rm = T)  # Complication
  b.08[, COMP[i] ] <- sum( dat[, COMP[i]] == 'NoComplication', na.rm = T)  # No Complication
  c.08[, COMP[i] ] <- sum( dat[, 'DEATH'] == 1, na.rm=T)                   # Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH', COMP[i])]
  p.c.08[, COMP[i] ]  <- mean(bla$DEATH == 1, na.rm = T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH', COMP[i])]
  p.nc.08[, COMP[i] ] <- mean(bla$DEATH == 1, na.rm = T)
  Comp.Rate.08[, COMP[i] ] <- mean(dat[[ COMP[i] ]] != 'NoComplication', na.rm = T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a = a.08[1, j], b = b.08[1, j], c = c.08[1, j], OR = OR[j], p.c = p.c.08[1, j], p.nc = p.nc.08[1,
j])
  Adj.AM.08[1, j]   <- lala$AM.adj
  Unadj.AM.08[1, j] <- lala$AM.unadj
  x.08[1, j]        <- lala$x
  y.08[1, j]        <- lala$y
  N.08[1, j]        <- lala$N
  comp.perc.08[1, j]  <- lala$comp.perc
  death.perc.08[1, j] <- lala$death.perc
}

g.08.bleed <- function(x) {
  a0 <- 270026*exp(x)-270026
  b0 <- 1227*exp(x)-4629*exp(x)+270026+4629
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-4629)))/(2*a0)
  x0 <- (4629-270026*y0)/1227
  1227*(x0-y0)
}
g.08.thromb <- function(x) {
  a0 <- 268588*exp(x)-268588
  b0 <- 2665*exp(x)-4629*exp(x)+268588+4629
```

```
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-4629)))/(2*a0)
  x0 <- (4629-268588*y0)/2665
  2665*(x0-y0)
}

g.08.bleed(x=Beta[1] )
(g.prim <- grad(func=g.08.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.08.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.08[1,1] + c(-1, 1)*1.96*AM.se)

g.08.thromb(x=Beta[2])
(g.prim <- grad(func=g.08.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.08.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.08[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.08 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.08[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.08[1,1], Y=y.08[1,1], N=N.08[1,1], comp.perc=comp.perc.08[1,1], death.perc=death.perc.08[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.08[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.08[1,2], Y=y.08[1,2], N=N.08[1,2], comp.perc=comp.perc.08[1,2], death.perc=death.perc.08[1,2]))
)
rownames(OUTPUT.08) <- NULL
OUTPUT.08$YEAR <- 2008
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.08)

# Year 2009 AM.OR ####
load('ModelResults_Y09.Rdata')

dat <-  dat09; YEAR <- '2009'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.09, YEAR='Year 2009')$OR
Beta <- OR.cal(obj=fit.09, YEAR='Year 2009')$Beta
SE   <- OR.cal(obj=fit.09, YEAR='Year 2009')$SE
PVAL <- OR.cal(obj=fit.09, YEAR='Year 2009')$PVAL
OR.LOW <- OR.cal(obj=fit.09, YEAR='Year 2009')$LOW
OR.UPP <- OR.cal(obj=fit.09, YEAR='Year 2009')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.09 <- b.09 <- c.09 <- p.c.09 <- p.nc.09 <- Comp.Rate.09 <- Adj.AM.09 <- Unadj.AM.09 <- matrix(NA, nrow=1, ncol=2)
N.09 <- comp.perc.09 <- death.perc.09 <- x.09 <- y.09 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.09[, COMP[i] ] <- sum( dat[, COMP[i]] != 'NoComplication', na.rm = T)  # Complication
  b.09[, COMP[i] ] <- sum( dat[, COMP[i]] == 'NoComplication', na.rm = T)  # No Complication
  c.09[, COMP[i] ] <- sum( dat[, 'DEATH'] == 1, na.rm = T)                 # Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH', COMP[i])]
  p.c.09[, COMP[i] ]  <- mean(bla$DEATH == 1, na.rm = T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH', COMP[i])]
  p.nc.09[, COMP[i] ] <- mean(bla$DEATH == 1, na.rm=T)
  Comp.Rate.09[, COMP[i] ] <- mean(dat[[ COMP[i] ]] != 'NoComplication', na.rm = T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a = a.09[1, j], b = b.09[1, j], c = c.09[1, j], OR = OR[j], p.c = p.c.09[1, j], p.nc = p.nc.09[1,
j])
  Adj.AM.09[1, j]   <- lala$AM.adj
  Unadj.AM.09[1, j] <- lala$AM.unadj
  x.09[1, j]        <- lala$x
  y.09[1, j]        <- lala$y
  N.09[1, j]        <- lala$N
  comp.perc.09[1, j]  <- lala$comp.perc
  death.perc.09[1, j] <- lala$death.perc
}

g.09.bleed <- function(x) {
  a0 <- 334634*exp(x)-334634
  b0 <- 1464*exp(x)-5391*exp(x)+334634+5391
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-5391)))/(2*a0)
  x0 <- (5391-334634*y0)/1464
  1464*(x0-y0)
}
g.09.thromb <- function(x) {
  a0 <- 333069*exp(x)-333069
```

```
  b0 <- 3029*exp(x)-5391*exp(x)+333069+5391
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-5391)))/(2*a0)
  x0 <- (5391-333069*y0)/3029
  3029*(x0-y0)
}

g.09.bleed(x=Beta[1] )
(g.prim <- grad(func=g.09.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.09.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.09[1,1] + c(-1, 1)*1.96*AM.se)

g.09.thromb(x=Beta[2])
(g.prim <- grad(func=g.09.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.09.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.09[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.09 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.09[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.09[1,1], Y=y.09[1,1], N=N.09[1,1], comp.perc=comp.perc.09[1,1], death.perc=death.perc.09[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.09[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.09[1,2], Y=y.09[1,2], N=N.09[1,2], comp.perc=comp.perc.09[1,2], death.perc=death.perc.09[1,2]))
)
rownames(OUTPUT.09) <- NULL
OUTPUT.09$YEAR <- 2009
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.09)

# Year 2010 AM.OR ####
load('ModelResults_Y10.Rdata')

dat <-  dat10; YEAR <- '2010'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.10, YEAR='Year 2010')$OR
Beta <- OR.cal(obj=fit.10, YEAR='Year 2010')$Beta
SE   <- OR.cal(obj=fit.10, YEAR='Year 2010')$SE
PVAL <- OR.cal(obj=fit.10, YEAR='Year 2010')$PVAL
OR.LOW <- OR.cal(obj=fit.10, YEAR='Year 2010')$LOW
OR.UPP <- OR.cal(obj=fit.10, YEAR='Year 2010')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.10 <- b.10 <- c.10 <- p.c.10 <- p.nc.10 <- Comp.Rate.10 <- Adj.AM.10 <- Unadj.AM.10 <- matrix(NA, nrow=1, ncol=2)
N.10 <- comp.perc.10 <- death.perc.10 <- x.10 <- y.10 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.10[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.10[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.10[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.10[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.10[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.10[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.10[1,j], b=b.10[1,j], c=c.10[1,j], OR=OR[j], p.c=p.c.10[1,j], p.nc=p.nc.10[1,j])
  Adj.AM.10[1,j]   <- lala$AM.adj
  Unadj.AM.10[1,j] <- lala$AM.unadj
  x.10[1,j]        <- lala$x
  y.10[1,j]        <- lala$y
  N.10[1,j]        <- lala$N
  comp.perc.10[1,j]  <- lala$comp.perc
  death.perc.10[1,j] <- lala$death.perc
}

g.10.bleed <- function(x) {
  a0 <- 341192*exp(x)-341192
  b0 <- 22182*exp(x)-6162*exp(x)+341192+6162
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6162)))/(2*a0)
  x0 <- (6162-341192*y0)/22182
  22182*(x0-y0)
}
g.10.thromb <- function(x) {
  a0 <- 360013*exp(x)-360013
```

```
  b0 <- 3361*exp(x)-6162*exp(x)+360013+6162
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6162)))/(2*a0)
  x0 <- (6162-360013*y0)/3361
  3361*(x0-y0)
}

g.10.bleed(x=Beta[1] )
(g.prim <- grad(func=g.10.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.10.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.10[1,1] + c(-1, 1)*1.96*AM.se)

g.10.thromb(x=Beta[2])
(g.prim <- grad(func=g.10.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.10.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.10[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.10 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.10[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.10[1,1], Y=y.10[1,1], N=N.10[1,1], comp.perc=comp.perc.10[1,1], death.perc=death.perc.10[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.10[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.10[1,2], Y=y.10[1,2], N=N.10[1,2], comp.perc=comp.perc.10[1,2], death.perc=death.perc.10[1,2]))
)
rownames(OUTPUT.10) <- NULL
OUTPUT.10$YEAR <- 2010
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.10)

# Year 2011 AM.OR ####
load('ModelResults_Y11.Rdata')

dat <- dat11; YEAR <- '2011'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.11, YEAR='Year 2011')$OR
Beta <- OR.cal(obj=fit.11, YEAR='Year 2011')$Beta
SE   <- OR.cal(obj=fit.11, YEAR='Year 2011')$SE
PVAL <- OR.cal(obj=fit.11, YEAR='Year 2011')$PVAL
OR.LOW <- OR.cal(obj=fit.11, YEAR='Year 2011')$LOW
OR.UPP <- OR.cal(obj=fit.11, YEAR='Year 2011')$UPP

a.11 <- b.11 <- c.11 <- p.c.11 <- p.nc.11 <- Comp.Rate.11 <- Adj.AM.11 <- Unadj.AM.11 <- matrix(NA, nrow=1, ncol=2)
N.11 <- comp.perc.11 <- death.perc.11 <- x.11 <- y.11 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.11[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.11[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.11[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.11[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.11[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.11[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.11[1,j], b=b.11[1,j], c=c.11[1,j], OR=OR[j], p.c=p.c.11[1,j], p.nc=p.nc.11[1,j])
  Adj.AM.11[1,j]   <- lala$AM.adj
  Unadj.AM.11[1,j] <- lala$AM.unadj
  x.11[1,j]        <- lala$x
  y.11[1,j]        <- lala$y
  N.11[1,j]        <- lala$N
  comp.perc.11[1,j]  <- lala$comp.perc
  death.perc.11[1,j] <- lala$death.perc
}

g.11.bleed <- function(x) {
  a0 <- 404959*exp(x)-404959
  b0 <- 37121*exp(x)-6982*exp(x)+404959+6982
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6982)))/(2*a0)
  x0 <- (6982-404959*y0)/37121
  37121*(x0-y0)
}
g.11.thromb <- function(x) {
  a0 <- 438049*exp(x)-438049
  b0 <- 4031*exp(x)-6982*exp(x)+438049+6982
```

```
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6982)))/(2*a0)
  x0 <- (6982-438049*y0)/4031
  4031*(x0-y0)
}

g.11.bleed(x=Beta[1] )
(g.prim <- grad(func=g.11.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.11.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.11[1,1] + c(-1, 1)*1.96*AM.se)

g.11.thromb(x=Beta[2])
(g.prim <- grad(func=g.11.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.11.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.11[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.11 <- rbind(
  data.frame(Comp='BLEED',
           AM=Adj.AM.11[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
           OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
           X=x.11[1,1], Y=y.11[1,1], N=N.11[1,1], comp.perc=comp.perc.11[1,1], death.perc=death.perc.11[1,1]),
  data.frame(Comp='VTE',
           AM=Adj.AM.11[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
           OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
           X=x.11[1,2], Y=y.11[1,2], N=N.11[1,2], comp.perc=comp.perc.11[1,2], death.perc=death.perc.11[1,2]))
)
rownames(OUTPUT.11) <- NULL
OUTPUT.11$YEAR <- 2011
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.11)

# Year 2012 AM.OR ####
load('ModelResults_Y12.Rdata')

dat <- dat12; YEAR <- '2012'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.12, YEAR='Year 2012')$OR
Beta <- OR.cal(obj=fit.12, YEAR='Year 2012')$Beta
SE   <- OR.cal(obj=fit.12, YEAR='Year 2012')$SE
PVAL <- OR.cal(obj=fit.12, YEAR='Year 2012')$PVAL
OR.LOW <- OR.cal(obj=fit.12, YEAR='Year 2012')$LOW
OR.UPP <- OR.cal(obj=fit.12, YEAR='Year 2012')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.12 <- b.12 <- c.12 <- p.c.12 <- p.nc.12 <- Comp.Rate.12 <- Adj.AM.12 <- Unadj.AM.12 <- matrix(NA, nrow=1, ncol=2)
N.12 <- comp.perc.12 <- death.perc.12 <- x.12 <- y.12 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.12[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.12[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.12[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.12[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.12[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.12[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.12[1,j], b=b.12[1,j], c=c.12[1,j], OR=OR[j], p.c=p.c.12[1,j], p.nc=p.nc.12[1,j])
  Adj.AM.12[1,j]   <- lala$AM.adj
  Unadj.AM.12[1,j] <- lala$AM.unadj
  x.12[1,j]        <- lala$x
  y.12[1,j]        <- lala$y
  N.12[1,j]        <- lala$N
  comp.perc.12[1,j]  <- lala$comp.perc
  death.perc.12[1,j] <- lala$death.perc
}

g.12.bleed <- function(x) {
  a0 <- 503340*exp(x)-503340
  b0 <- 40500*exp(x)-6838*exp(x)+503340+6838
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6838)))/(2*a0)
  x0 <- (6838-503340*y0)/40500
  40500*(x0-y0)
}
g.12.thromb <- function(x) {
  a0 <- 539133*exp(x)-539133
  b0 <- 4707*exp(x)-6838*exp(x)+539133+6838
```

```
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-6838)))/(2*a0)
  x0 <- (6838-539133*y0)/4707
  4707*(x0-y0)
}

g.12.bleed(x=Beta[1] )
(g.prim <- grad(func=g.12.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.12.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.12[1,1] + c(-1, 1)*1.96*AM.se)

g.12.thromb(x=Beta[2])
(g.prim <- grad(func=g.12.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.12.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.12[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.12 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.12[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.12[1,1], Y=y.12[1,1], N=N.12[1,1], comp.perc=comp.perc.12[1,1], death.perc=death.perc.12[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.12[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.12[1,2], Y=y.12[1,2], N=N.12[1,2], comp.perc=comp.perc.12[1,2], death.perc=death.perc.12[1,2]))
)
rownames(OUTPUT.12) <- NULL
OUTPUT.12$YEAR <- 2012
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.12)


# Year 2013 AM.OR ####
load('ModelResults_Y13.Rdata')

dat <- dat13; YEAR <- '2013'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.13, YEAR='Year 2013')$OR
Beta <- OR.cal(obj=fit.13, YEAR='Year 2013')$Beta
SE   <- OR.cal(obj=fit.13, YEAR='Year 2013')$SE
PVAL <- OR.cal(obj=fit.13, YEAR='Year 2013')$PVAL
OR.LOW <- OR.cal(obj=fit.13, YEAR='Year 2013')$LOW
OR.UPP <- OR.cal(obj=fit.13, YEAR='Year 2013')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.13 <- b.13 <- c.13 <- p.c.13 <- p.nc.13 <- Comp.Rate.13 <- Adj.AM.13 <- Unadj.AM.13 <- matrix(NA, nrow=1, ncol=2)
N.13 <- comp.perc.13 <- death.perc.13 <- x.13 <- y.13 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.13[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.13[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.13[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.13[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.13[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.13[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.13[1,j], b=b.13[1,j], c=c.13[1,j], OR=OR[j], p.c=p.c.13[1,j], p.nc=p.nc.13[1,j])
  Adj.AM.13[1,j]   <- lala$AM.adj
  Unadj.AM.13[1,j] <- lala$AM.unadj
  x.13[1,j]        <- lala$x
  y.13[1,j]        <- lala$y
  N.13[1,j]        <- lala$N
  comp.perc.13[1,j]  <- lala$comp.perc
  death.perc.13[1,j] <- lala$death.perc
}

g.13.bleed <- function(x) {
  a0 <- 608469*exp(x)-608469
  b0 <- 43420*exp(x)-7877*exp(x)+608469+7877
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-7877)))/(2*a0)
  x0 <- (7877-608469*y0)/43420
  43420*(x0-y0)
}
g.13.thromb <- function(x) {
  a0 <- 646373*exp(x)-646373
```

```
  b0 <- 5516*exp(x)-7877*exp(x)+646373+7877
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-7877)))/(2*a0)
  x0 <- (7877-646373*y0)/5516
  5516*(x0-y0)
}

g.13.bleed(x=Beta[1] )
(g.prim <- grad(func=g.13.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.13.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.13[1,1] + c(-1, 1)*1.96*AM.se)

g.13.thromb(x=Beta[2])
(g.prim <- grad(func=g.13.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.13.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.13[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.13 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.13[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.13[1,1], Y=y.13[1,1], N=N.13[1,1], comp.perc=comp.perc.13[1,1], death.perc=death.perc.13[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.13[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.13[1,2], Y=y.13[1,2], N=N.13[1,2], comp.perc=comp.perc.13[1,2], death.perc=death.perc.13[1,2]))
)
rownames(OUTPUT.13) <- NULL
OUTPUT.13$YEAR <- 2013
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.13)

# Year 2014 AM.OR ####
load('ModelResults_Y14.Rdata')

dat <- dat14; YEAR <- '2014'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.14, YEAR='Year 2014')$OR
Beta <- OR.cal(obj=fit.14, YEAR='Year 2014')$Beta
SE   <- OR.cal(obj=fit.14, YEAR='Year 2014')$SE
PVAL <- OR.cal(obj=fit.14, YEAR='Year 2014')$PVAL
OR.LOW <- OR.cal(obj=fit.14, YEAR='Year 2014')$LOW
OR.UPP <- OR.cal(obj=fit.14, YEAR='Year 2014')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.14 <- b.14 <- c.14 <- p.c.14 <- p.nc.14 <- Comp.Rate.14 <- Adj.AM.14 <- Unadj.AM.14 <- matrix(NA, nrow=1, ncol=2)
N.14 <- comp.perc.14 <- death.perc.14 <- x.14 <- y.14 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.14[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.14[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.14[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.14[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.14[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.14[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.14[1,j], b=b.14[1,j], c=c.14[1,j], OR=OR[j], p.c=p.c.14[1,j], p.nc=p.nc.14[1,j])
  Adj.AM.14[1,j]   <- lala$AM.adj
  Unadj.AM.14[1,j] <- lala$AM.unadj
  x.14[1,j]        <- lala$x
  y.14[1,j]        <- lala$y
  N.14[1,j]        <- lala$N
  comp.perc.14[1,j]  <- lala$comp.perc
  death.perc.14[1,j] <- lala$death.perc
}

g.14.bleed <- function(x) {
  a0 <- 707096*exp(x)-707096
  b0 <- 43805*exp(x)-9185*exp(x)+707096+9185
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-9185)))/(2*a0)
  x0 <- (9185-707096*y0)/43805
  43805*(x0-y0)
}
g.14.thromb <- function(x) {
  a0 <- 744593*exp(x)-744593
```

```
  b0 <- 6308*exp(x)-9185*exp(x)+744593+9185
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-9185)))/(2*a0)
  x0 <- (9185-744593*y0)/6308
  6308*(x0-y0)
}

g.14.bleed(x=Beta[1] )
(g.prim <- grad(func=g.14.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.14.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.14[1,1] + c(-1, 1)*1.96*AM.se)

g.14.thromb(x=Beta[2])
(g.prim <- grad(func=g.14.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.14.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.14[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.14 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.14[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.14[1,1], Y=y.14[1,1], N=N.14[1,1], comp.perc=comp.perc.14[1,1], death.perc=death.perc.14[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.14[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.14[1,2], Y=y.14[1,2], N=N.14[1,2], comp.perc=comp.perc.14[1,2], death.perc=death.perc.14[1,2]))
)
rownames(OUTPUT.14) <- NULL
OUTPUT.14$YEAR <- 2014
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.14)


# Year 2015 AM.OR ####
load('ModelResults_Y15.Rdata')

dat <- dat15; YEAR <- '2015'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.15, YEAR='Year 2015')$OR
Beta <- OR.cal(obj=fit.15, YEAR='Year 2015')$Beta
SE   <- OR.cal(obj=fit.15, YEAR='Year 2015')$SE
PVAL <- OR.cal(obj=fit.15, YEAR='Year 2015')$PVAL
OR.LOW <- OR.cal(obj=fit.15, YEAR='Year 2015')$LOW
OR.UPP <- OR.cal(obj=fit.15, YEAR='Year 2015')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.15 <- b.15 <- c.15 <- p.c.15 <- p.nc.15 <- Comp.Rate.15 <- Adj.AM.15 <- Unadj.AM.15 <- matrix(NA, nrow=1, ncol=2)
N.15 <- comp.perc.15 <- death.perc.15 <- x.15 <- y.15 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.15[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  # Complication
  b.15[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  # No Complication
  c.15[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.15[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.15[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.15[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}
for (j in 1:2) {

  lala <- a.mort.cal(a=a.15[1,j], b=b.15[1,j], c=c.15[1,j], OR=OR[j], p.c=p.c.15[1,j], p.nc=p.nc.15[1,j])
  Adj.AM.15[1,j]   <- lala$AM.adj
  Unadj.AM.15[1,j] <- lala$AM.unadj
  x.15[1,j]        <- lala$x
  y.15[1,j]        <- lala$y
  N.15[1,j]        <- lala$N
  comp.perc.15[1,j]  <- lala$comp.perc
  death.perc.15[1,j] <- lala$death.perc
}

g.15.bleed <- function(x) {
  a0 <- 839838*exp(x)-839838
  b0 <- 45620*exp(x)-10683*exp(x)+839838+10683
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-10683)))/(2*a0)
  x0 <- (10683-839838*y0)/45620
  45620*(x0-y0)
}
g.15.thromb <- function(x) {
  a0 <- 878011*exp(x)-878011
```

```
  b0 <- 7447*exp(x)-10683*exp(x)+878011+10683
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-10683)))/(2*a0)
  x0 <- (10683-878011*y0)/7447
  7447*(x0-y0)
}

g.15.bleed(x=Beta[1] )
(g.prim <- grad(func=g.15.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.15.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.15[1,1] + c(-1, 1)*1.96*AM.se)

g.15.thromb(x=Beta[2])
(g.prim <- grad(func=g.15.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.15.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.15[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.15 <- rbind(
  data.frame(Comp='BLEED',
             AM=Adj.AM.15[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.15[1,1], Y=y.15[1,1], N=N.15[1,1], comp.perc=comp.perc.15[1,1], death.perc=death.perc.15[1,1]),
  data.frame(Comp='VTE',
             AM=Adj.AM.15[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.15[1,2], Y=y.15[1,2], N=N.15[1,2], comp.perc=comp.perc.15[1,2], death.perc=death.perc.15[1,2]))
)
rownames(OUTPUT.15) <- NULL
OUTPUT.15$YEAR <- 2015
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.15)


# Year 2016 AM.OR ####
load('ModelResults_Y16.Rdata')

dat <- dat16; YEAR <- '2016'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.16, YEAR='Year 2016')$OR
Beta <- OR.cal(obj=fit.16, YEAR='Year 2016')$Beta
SE   <- OR.cal(obj=fit.16, YEAR='Year 2016')$SE
PVAL <- OR.cal(obj=fit.16, YEAR='Year 2016')$PVAL
OR.LOW <- OR.cal(obj=fit.16, YEAR='Year 2016')$LOW
OR.UPP <- OR.cal(obj=fit.16, YEAR='Year 2016')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.16 <- b.16 <- c.16 <- p.c.16 <- p.nc.16 <- Comp.Rate.16 <- Adj.AM.16 <- Unadj.AM.16 <- matrix(NA, nrow=1, ncol=2)
N.16 <- comp.perc.16 <- death.perc.16 <- x.16 <- y.16 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.16[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.16[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.16[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.16[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.16[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.16[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.16[1,j], b=b.16[1,j], c=c.16[1,j], OR=OR[j], p.c=p.c.16[1,j], p.nc=p.nc.16[1,j])
  Adj.AM.16[1,j]   <- lala$AM.adj
  Unadj.AM.16[1,j] <- lala$AM.unadj
  x.16[1,j]        <- lala$x
  y.16[1,j]        <- lala$y
  N.16[1,j]        <- lala$N
  comp.perc.16[1,j]  <- lala$comp.perc
  death.perc.16[1,j] <- lala$death.perc
}

g.16.bleed <- function(x) {
  a0 <- 953507*exp(x)-953507
  b0 <- 46844*exp(x)-11422*exp(x)+953507+11422
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-11422)))/(2*a0)
  x0 <- (11422-953507*y0)/46844
  46844*(x0-y0)
}
g.16.thromb <- function(x) {
```

```
  a0 <- 992323*exp(x)-992323
  b0 <- 8028*exp(x)-11422*exp(x)+992323+11422
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-11422)))/(2*a0)
  x0 <- (11422-992323*y0)/8028
  8028*(x0-y0)
}

g.16.bleed(x=Beta[1] )
(g.prim <- grad(func=g.16.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.16.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.16[1,1] + c(-1, 1)*1.96*AM.se)

g.16.thromb(x=Beta[2])
(g.prim <- grad(func=g.16.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.16.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.16[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.16 <- rbind(
  data.frame(Comp='BLEED',  AM=Adj.AM.16[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],    OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.16[1,1], Y=y.16[1,1], N=N.16[1,1], comp.perc=comp.perc.16[1,1], death.perc=death.perc.16[1,1]),
  data.frame(Comp='VTE', AM=Adj.AM.16[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.16[1,2], Y=y.16[1,2], N=N.16[1,2], comp.perc=comp.perc.16[1,2], death.perc=death.perc.16[1,2]))
)
rownames(OUTPUT.16) <- NULL
OUTPUT.16$YEAR <- 2016
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.16)


# Year 2017 AM.OR ####
load('ModelResults_Y17.Rdata')

dat <- dat17; YEAR <- '2017'
COMP <- c("OTHBLEED","VTE")

OR   <- OR.cal(obj=fit.17, YEAR='Year 2017')$OR
Beta <- OR.cal(obj=fit.17, YEAR='Year 2017')$Beta
SE   <- OR.cal(obj=fit.17, YEAR='Year 2017')$SE
PVAL <- OR.cal(obj=fit.17, YEAR='Year 2017')$PVAL
OR.LOW <- OR.cal(obj=fit.17, YEAR='Year 2017')$LOW
OR.UPP <- OR.cal(obj=fit.17, YEAR='Year 2017')$UPP

## Attributable mortality based on adjusted OR and observed complication prevalence
a.17 <- b.17 <- c.17 <- p.c.17 <- p.nc.17 <- Comp.Rate.17 <- Adj.AM.17 <- Unadj.AM.17 <- matrix(NA, nrow=1, ncol=2)
N.17 <- comp.perc.17 <- death.perc.17 <- x.17 <- y.17 <- matrix(NA, nrow=1, ncol=2)

for ( i in 1:length(COMP) ) {
  a.17[, COMP[i] ] <- sum( dat[,COMP[i]]!='NoComplication', na.rm=T)  #Complication
  b.17[, COMP[i] ] <- sum( dat[,COMP[i]]=='NoComplication', na.rm=T)  #No Complication
  c.17[, COMP[i] ] <- sum( dat[,'DEATH']==1, na.rm=T) #Death

  bla <- dat[ dat[[ COMP[i] ]] != 'NoComplication', c('DEATH',COMP[i])]
  p.c.17[, COMP[i] ]  <- mean(bla$DEATH==1, na.rm=T)
  bla <- dat[ dat[[ COMP[i] ]] == 'NoComplication', c('DEATH',COMP[i])]
  p.nc.17[, COMP[i] ] <- mean(bla$DEATH==1, na.rm=T)
  Comp.Rate.17[, COMP[i] ] <- mean(dat[[ COMP[i] ]]!='NoComplication', na.rm=T)
}

for (j in 1:2) {

  lala <- a.mort.cal(a=a.17[1,j], b=b.17[1,j], c=c.17[1,j], OR=OR[j], p.c=p.c.17[1,j], p.nc=p.nc.17[1,j])
  Adj.AM.17[1,j]   <- lala$AM.adj
  Unadj.AM.17[1,j] <- lala$AM.unadj
  x.17[1,j]        <- lala$x
  y.17[1,j]        <- lala$y
  N.17[1,j]        <- lala$N
  comp.perc.17[1,j]  <- lala$comp.perc
  death.perc.17[1,j] <- lala$death.perc
}

g.17.bleed <- function(x) {
  a0 <- 982665*exp(x)-982665
  b0 <- 45999*exp(x)-11291*exp(x)+982665+11291
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-11291)))/(2*a0)
  x0 <- (11291-982665*y0)/45999
  45999*(x0-y0)
}
g.17.thromb <- function(x) {
  a0 <- 1020415*exp(x)-1020415
```

```
  b0 <- 8249*exp(x)-11291*exp(x)+1020415+11291
  y0 <- (-b0 + sqrt( b0^2 -4*a0*(-11291)))/(2*a0)
  x0 <- (11291-1020415*y0)/8249
  8249*(x0-y0)
}

g.17.bleed(x=Beta[1] )
(g.prim <- grad(func=g.17.bleed, x=Beta[1]))
(AM.se <- abs(grad(func=g.17.bleed, x=Beta[1])*SE[1]))
(AM.CI.1 <- Adj.AM.17[1,1] + c(-1, 1)*1.96*AM.se)

g.17.thromb(x=Beta[2])
(g.prim <- grad(func=g.17.thromb, x=Beta[2]))
(AM.se <- abs(grad(func=g.17.thromb, x=Beta[2])*SE[2]))
(AM.CI.2 <- Adj.AM.17[1,2] + c(-1, 1)*1.96*AM.se)

(OUTPUT.17 <- rbind(
  data.frame(Comp='BLEED',  AM=Adj.AM.17[1,1], AM.LOW=AM.CI.1[1], AM.UPP=AM.CI.1[2],
             OR=OR[1],          OR.LOW=OR.LOW[1],  OR.UPP=OR.UPP[1], OR.PVAL=PVAL[1],
             X=x.17[1,1], Y=y.17[1,1], N=N.17[1,1], comp.perc=comp.perc.17[1,1], death.perc=death.perc.17[1,1]),
  data.frame(Comp='VTE', AM=Adj.AM.17[1,2], AM.LOW=AM.CI.2[1], AM.UPP=AM.CI.2[2],
             OR=OR[2],          OR.LOW=OR.LOW[2],  OR.UPP=OR.UPP[2], OR.PVAL=PVAL[2],
             X=x.17[1,2], Y=y.17[1,2], N=N.17[1,2], comp.perc=comp.perc.17[1,2], death.perc=death.perc.17[1,2]))
)
rownames(OUTPUT.17) <- NULL
OUTPUT.17$YEAR <- 2017
OUTPUT.ALL <- rbind(OUTPUT.ALL, OUTPUT.17)
```