Gamma imputation - simulation study

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```
#replication of simulation study performed by Jackson et al DOI: 10.1002/sim.6274
#we perform 100 simulations per value of gamma, whereas Jackson et al used 1000

#load informative censoring package
library(InformativeCensoring)
```

```
## Loading required package: survival
## Loading required package: splines
##
## Attaching package: 'InformativeCensoring'
##
## The following object is masked from 'package:survival':
##
##     cox.zph
```

```
library(survival)

runSim <- function(nSim=100,n=100,gamma=0) {

  ICEst <- array(0, dim=c(nSim,2))
  ICCI <- array(0, dim=c(nSim,4))
  miEst <- array(0, dim=c(nSim,2))
  miCI <- array(0, dim=c(nSim,4))
  trueEst <- array(0, dim=c(nSim,2))
  for (sim in 1:nSim) {
    u <- runif(n)
    z <- rep(0, n)
    z[(u>0.5) & (u<0.8)] <- 1
    z[u>0.8] <- 2

    #generate censoring time
    c <- rexp(n, rate=0.3)
    lambda <- 0.03+0.02*(z==1)+0.06*(z==2)
    t <- rexp(n, rate=lambda)

    y <- t
    y[c<t] <- c[c<t]
    y[y>3] <- 3

    delta <- 1*(y==t)

    #note that thus far T and C are independent
    library(survival)
    ICmod <- coxph(Surv(y,delta)~factor(z))
    ICEst[sim,] <- coef(ICmod)
    ICCI[sim,1:2] <- log(summary(ICmod)$conf.int[1,3:4])
```

```
    ICCI[sim,3:4] <- log(summary(ICmod)$conf.int[2,3:4])

    #now we apply the gamma imputation approach
    data <- data.frame(y,delta,z=factor(z))
    imputed <- gammaImpute(formula=Surv(y,delta)~z, data=data, m=10, gamma=rep(gamma,n), DCO.time = 3)
    fits <- ImputeStat(imputed)
    s <- summary(fits)
    miEst[sim,] <- s[,1]
    miCI[sim,1:2] <- s[1,6:7]
    miCI[sim,3:4] <- s[2,6:7]

    #now we simulate what would have been observed in the absence of censoring
    tstar <- t
    a <- rexp(n, rate=lambda*exp(gamma))
    tstar[t>c] <- c[t>c]+a[t>c]
    #in their paper, Jackson et al again censor tstar at 3
    delta <- 1*(tstar<3)
    tstar[delta==0] <- 3

    truemod <- coxph(Surv(tstar,delta)~factor(z))
    trueEst[sim,] <- coef(truemod)
    #in the way Jackson et al have done it, these now become the 'true' log hazard ratios
  }

  list(ICEst=ICEst, ICCI=ICCI, miEst=miEst, miCI=miCI, trueEst=trueEst)
}

gammaseq <- seq(-2,5,1)
resultsTable <- array(0, dim=c(length(gammaseq), 9))
resultsTable[,1] <- gammaseq

for (i in 1:length(gammaseq)) {
  gammaval <- gammaseq[i]
  print(paste("Gamma = ", gammaval, sep=""))
  results <- runSim(nSim=100,n=1000,gammaval)
  #calculate bias, as defined in Jackson paper
  truth <- colMeans(results$trueEst)

  ICbias <- colMeans(results$ICEst)-colMeans(results$trueEst)
  MIbias <- colMeans(results$miEst)-colMeans(results$trueEst)

  ICCI1 <- ((results$ICCI[,1]<truth[1]) & (results$ICCI[,2]>truth[1]))
  ICCI2 <- ((results$ICCI[,3]<truth[2]) & (results$ICCI[,4]>truth[2]))
  miCI1 <- ((results$miCI[,1]<truth[1]) & (results$miCI[,2]>truth[1]))
  miCI2 <- ((results$miCI[,3]<truth[2]) & (results$miCI[,4]>truth[2]))

  #save to results table, mirroring formatting in Jackson paper
  resultsTable[i,2:9] <- c(MIbias[1], ICbias[1], mean(miCI1), mean(ICCI1), MIbias[2], ICbias[2], mean(m
}
```

```
## [1] "Gamma = -2"
## [1] "Gamma = -1"
## [1] "Gamma = 0"
```

```
## [1] "Gamma = 1"
## [1] "Gamma = 2"
## [1] "Gamma = 3"
## [1] "Gamma = 4"
## [1] "Gamma = 5"
```

```
colnames(resultsTable) <- c("Gamma", "MI bias 1", "IC bias 1", "MI CI 1", "IC CI 1",  "MI bias 2", "IC b

format(round(resultsTable, 2), nsmall=2)
```

```
##      Gamma   MI bias 1 IC bias 1 MI CI 1 IC CI 1 MI bias 2 IC bias 2
## [1,] "-2.00" " 0.01"   " 0.00"   " 0.95" " 0.95" "-0.01"   " 0.01"
## [2,] "-1.00" " 0.01"   " 0.01"   " 0.95" " 0.95" " 0.00"   " 0.01"
## [3,] " 0.00" " 0.02"   " 0.02"   " 0.98" " 0.98" " 0.03"   " 0.03"
## [4,] " 1.00" "-0.02"   "-0.02"   " 0.95" " 0.94" "-0.01"   " 0.01"
## [5,] " 2.00" "-0.03"   " 0.03"   " 0.89" " 0.90" "-0.01"   " 0.13"
## [6,] " 3.00" "-0.01"   " 0.12"   " 0.93" " 0.93" "-0.02"   " 0.36"
## [7,] " 4.00" " 0.01"   " 0.35"   " 0.97" " 0.73" " 0.01"   " 0.74"
## [8,] " 5.00" " 0.01"   " 0.43"   " 0.94" " 0.61" " 0.01"   " 0.89"
##      MI CI 2 IC CI 2
## [1,] " 0.94" " 0.95"
## [2,] " 0.96" " 0.96"
## [3,] " 0.92" " 0.95"
## [4,] " 0.93" " 0.95"
## [5,] " 0.94" " 0.91"
## [6,] " 0.91" " 0.76"
## [7,] " 0.92" " 0.17"
## [8,] " 0.93" " 0.06"
```