AFT-Simulation(8.10)

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```
# Log Normal

AFT_Simulation <- function(n,beta,lower,upper,
                           lower_cens, upper_cens,x6 = FALSE){

  if (x6 == TRUE){
    x = runif((length(beta)-1)*n,lower,upper)
    x6 = exp(1+rnorm(n))
    X_6 = matrix(x,n,(length(beta)-1))
    X = as.matrix(cbind(X_6[,1:5],x6,X_6[,6:(length(beta)-1)]))

  }else{
    x = runif(length(beta)*n,lower,upper)
    X = matrix(x,n,length(beta))
  }

  colnames(X) = paste0(1:10)
  time = exp(X%*%beta+rnorm(n))
  cens_time <- runif(n, min=lower_cens, max=upper_cens)
  Y <- pmin(time, cens_time)
  delta <- ifelse(time <= cens_time, 1, 0)
  return(list(Y=Y, delta=delta, Time = time,
              X = X))
}


tst <- AFT_Simulation(500, beta=c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0), lower=0, upper=1,  lower_cens=0,
head(tst$X)
```

```
##              1         2         3         4         5         6         7
## [1,] 0.59595345 0.3360014 0.2555860 0.5872644 0.9154722 11.280987 0.3766179
## [2,] 0.00660281 0.1521388 0.5248960 0.4992383 0.1384621  1.199714 0.5253145
## [3,] 0.58009816 0.6752143 0.9071987 0.2466018 0.4247726  6.612671 0.4956111
## [4,] 0.76618601 0.8049608 0.5155648 0.9529697 0.4802217  1.015787 0.7179869
## [5,] 0.57438991 0.5866901 0.6290070 0.0178626 0.8937551  1.151306 0.6040579
## [6,] 0.70544250 0.4015052 0.1702769 0.7726040 0.9598181  3.762480 0.5828694
##              8           9         10
## [1,] 0.1189425 0.819446071 0.55627907
## [2,] 0.1381809 0.004694395 0.67682585
## [3,] 0.5520738 0.715249405 0.10682056
## [4,] 0.4036489 0.692328093 0.98429412
```

```
## [5,] 0.6462469 0.511499469 0.29196098
## [6,] 0.1554984 0.011743847 0.02638958
```

See what it looks like for the observation generated by AFT

```
Y_delta = cbind(tst$Y,tst$delta)
colnames(Y_delta) = c("Y","Delta")
head(Y_delta)
```

```
##                Y Delta
## [1,] 14312.64638     0
## [2,]   110.08846     1
## [3,] 19960.07211     0
## [4,]    83.29427     1
## [5,]    30.39093     1
## [6,]  1166.33963     1
```

```
Cox = summary(coxph(Surv(tst$Y,tst$delta)~tst$X))
Cox
```

```
## Call:
## coxph(formula = Surv(tst$Y, tst$delta) ~ tst$X)
##
##   n= 500, number of events= 370
##
##              coef exp(coef) se(coef)       z Pr(>|z|)
## tst$X1   0.38920   1.47581  0.18461   2.108 0.035006 *
## tst$X2   0.72221   2.05898  0.19457   3.712 0.000206 ***
## tst$X3   0.11478   1.12163  0.19074   0.602 0.547324
## tst$X4  -3.21402   0.04019  0.21433 -14.996  < 2e-16 ***
## tst$X5  -0.09648   0.90803  0.20104  -0.480 0.631291
## tst$X6  -1.26375   0.28259  0.05779 -21.866  < 2e-16 ***
## tst$X7   0.25160   1.28609  0.18998   1.324 0.185389
## tst$X8   0.14041   1.15075  0.19441   0.722 0.470146
## tst$X9   0.21941   1.24534  0.18498   1.186 0.235580
## tst$X10  0.32419   1.38292  0.19087   1.698 0.089417 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## tst$X1     1.47581     0.6776   1.02776   2.11917
## tst$X2     2.05898     0.4857   1.40615   3.01489
## tst$X3     1.12163     0.8916   0.77177   1.63008
## tst$X4     0.04019    24.8789   0.02641   0.06118
## tst$X5     0.90803     1.1013   0.61231   1.34655
## tst$X6     0.28259     3.5387   0.25233   0.31649
## tst$X7     1.28609     0.7776   0.88625   1.86631
## tst$X8     1.15075     0.8690   0.78613   1.68447
## tst$X9     1.24534     0.8030   0.86663   1.78955
## tst$X10    1.38292     0.7231   0.95132   2.01033
##
## Concordance= 0.916  (se = 0.005 )
## Likelihood ratio test= 1037  on 10 df,   p=<2e-16
```

```
## Wald test            = 531  on 10 df,   p=<2e-16
## Score (logrank) test = 269.5  on 10 df,   p=<2e-16
```

```
AFT_EXP = summary(survreg(Surv(tst$Y, tst$delta) ~ -1+tst$X,
        dist="lognormal",scale = 1))
AFT_EXP
```

```
##
## Call:
## survreg(formula = Surv(tst$Y, tst$delta) ~ -1 + tst$X, dist = "lognormal",
##     scale = 1)
##             Value Std. Error     z      p
## tst$X1  -8.77e-02   1.68e-01 -0.52 0.6015
## tst$X2  -4.66e-01   1.71e-01 -2.73 0.0064
## tst$X3  -7.69e-05   1.77e-01  0.00 0.9997
## tst$X4   3.52e+00   1.62e-01 21.73 <2e-16
## tst$X5   3.32e-01   1.73e-01  1.92 0.0546
## tst$X6   1.24e+00   2.79e-02 44.46 <2e-16
## tst$X7  -1.37e-01   1.73e-01 -0.79 0.4278
## tst$X8  -6.41e-02   1.72e-01 -0.37 0.7088
## tst$X9  -6.20e-03   1.64e-01 -0.04 0.9699
## tst$X10 -3.66e-02   1.70e-01 -0.22 0.8292
##
## Scale fixed at 1
##
## Log Normal distribution
## Loglik(model)= -2076.4   Loglik(intercept only)= -4090.8
##  Chisq= 4028.8 on 9 degrees of freedom, p= 0
## Number of Newton-Raphson Iterations: 5
## n= 500
```

Prepare the parameter

```
system.time({

  result1 = MH_Sampling(tti,Y,Y.test,delta,delta.test,tau,
                        A,A.test,beta0,sigma0,var.prop,
                        m,B,eta,
                        Wmat_option=0)

})
```

```
##    user  system elapsed
##  107.65   31.93  195.80
```

```
system.time({

  result2 = MH_GP_Sampling(tti,Y,Y.test,delta,delta.test,tau,
                        A,A.all,beta0,alpha0,v0,kappa,
                        m,B,eta,K.all,n,
```

```
                        Wmat_option=0)



})
```

```
##    user  system elapsed
## 4805.81  144.06 6763.32
```

```
system.time({
  result3 = MH_horseshoe_Sampling(tti,Y,Y.test,delta,delta.test,tau,
                                  A,A.test,beta0,sigma0,var.prop,
                                  m,B,eta,v,
                                  Wmat_option=0)

})
```

```
##    user  system elapsed
##  102.97   33.76  214.82
```

```
Wmat = HarrellC_Wmat(Y,delta,tau)
Wmat.test = HarrellC_Wmat(Y.test,delta.test,tau)
```

```
all = data.frame(Model = c("Cox","Linear Regression","Gaussian Process",
                           "LR with horseshoe"),
        C_train = c(C_index(THETA(A,Cox$coefficients[,1]),Wmat),
                    C_index(colMeans(result1$THETA),Wmat),
                    C_index(colMeans(result2$BETA),Wmat),
                    C_index(colMeans(result3$THETA),Wmat)),
        C_test = c(C_index(THETA(A.test,Cox$coefficients[,1]),Wmat.test),
                   C_index(colMeans(result1$THETA.test),Wmat.test),
                   C_index(colMeans(result2$BETA_test),Wmat.test),
                   C_index(colMeans(result3$THETA.test),Wmat.test)),
        Spearman = c(cor(THETA(A.test,Cox$coefficients[,1]),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="spearman"),
                     cor(colMeans(result1$THETA.test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="spearman"),
                     cor(colMeans(result2$BETA_test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="spearman"),
                     cor(colMeans(result3$THETA.test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="spearman")),
        Kendall = c(cor(THETA(A.test,Cox$coefficients[,1]),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="kendall"),
                     cor(colMeans(result1$THETA.test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="kendall"),
                     cor(colMeans(result2$BETA_test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="kendall"),
                    cor(colMeans(result3$THETA.test),
                         THETA(A.test,c(-0.2,-0.1,-0.4,3.5,0.4,1.2,0,0,0,0)), method="kendall")
                     ))
all
```

```
##                Model C_train    C_test   Spearman    Kendall
## 1                Cox       1 0.9494949 -0.9940234 -0.9478788
## 2 Linear Regression       1 0.8787879 -0.8486289 -0.6472727
## 3  Gaussian Process       1 0.8484848 -0.7686049 -0.5862626
## 4 LR with horseshoe       1 0.9696970 -0.9187639 -0.7640404
```