

R code used to compute the joint posterior distribution in the context of a Weibull model

```
#####  
# Data of the new trial  
  
var_lik = cbind(t, status, trt, type)  
  
#####  
# Frequentist Weibull analysis  
  
f_w_s <- survreg(Surv(data$t, data$status)~data$trt, data = data, dist = "weibull")  
  
beta1 = data.frame(summary(f_w_s)$coefficients)[2,1]  
beta0 = data.frame(summary(f_w_s)$coefficients)[1,1]  
scale = f_w_s$scale  
  
theta = c(beta0, scale, beta1)  
  
#####  
# Historical individual control data  
  
hist_control <- subset(hist_control, select = c(t, status, trt, type))  
  
#####  
# Pool of historical individual control data and new data  
  
ind_data = rbind(var_lik, hist_control)  
  
var_ind_data = cbind(ind_data$t, ind_data$status, ind_data$trt, ind_data$type)  
  
data_all <- matrix(data = var_ind_data, nrow = dim(var_ind_data)[1], ncol = 4)  
  
#####  
# Bayesian Weibull analysis  
# theta = vector of parameters  
# data = pool of historical and new individual data  
# hr_hist = aggregate historical relative treatment effect  
# sd_hist = standard deviation of the historical relative treatment effect  
# hr_limit = threshold for the decision rule  
# prob_limit = Probability of posterior distribution (  $P(HR_{new} < hr\_limit) > prob\_limit$  )  
# nmcmc = number of mcmc  
# burn_in = number of burn_in  
#####  
  
bay_weibull <- function(theta, data, hr_hist, sd_hist, w, a0, hr_limit, prob_limit, nmcmc, burn_in)  
{  
  i <- 0  
  j <- 0  
  
  pool <- matrix(data = NA, nrow = length(theta) + 4, ncol = length(w))
```

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bw_beta1 <- matrix(data = NA, nrow = length(w), ncol = length(a0))

bw_beta1_sd <- matrix(data = NA, nrow = length(w), ncol = length(a0))
bw_beta1_inf <- matrix(data = NA, nrow = length(w), ncol = length(a0))
bw_beta1_sup <- matrix(data = NA, nrow = length(w), ncol = length(a0))

bw_beta0 <- matrix(data = NA, nrow = length(w), ncol = length(a0))
bw_scale <- matrix(data = NA, nrow = length(w), ncol = length(a0))

proportion <- matrix(data = NA, nrow = length(w), ncol = length(a0))

for (i in (1:length(a0)))
{
  for (j in (1:length(w)))
  {
    logpost <- function(theta, data)
    {
      beta0 = theta[1]
      scale = theta[2]
      beta1 = theta[3]

      t = data[,1]
      c = data[,2]
      trt = data[,3]

      logf = function(t, c, trt, beta0, scale, beta1, a0)
      {
        lambda = -(beta0 + beta1*trt) * (1/scale)

        llike = ifelse(data[,4] == 1, c * (log(1/scale) + ((1/scale)-1) * log(t) + lambda) - exp(lambda) *
(t^(1/scale)),
a0[i]*(c * (log(1/scale) + ((1/scale)-1) * log(t) + lambda) - exp(lambda) * (t^(1/scale))) )
        return(llike)
      }

      scale_p = dgamma(scale, shape = 0.0001, scale = 10000, log = TRUE)
      beta0_p = dnorm(beta0, 0, sqrt(10000), log = TRUE)
      mixture = w[j] * dnorm(-beta1/scale, log(hr_hist), sd_hist) + (1 - w[j]) * dnorm(-beta1/scale, 0,
sqrt(10))

      v_prior = beta0_p + log(-mixture/scale_p) + scale_p

      val_post = v_prior + sum(logf(t, c, trt, beta0, scale, beta1, a0))

      return(val_post)
    }

    start = c(beta0, scale, -beta1/scale)

    laplace = laplace(logpost, start, data)

```

```

proposal = list(var = laplace$var, scale = 1)

s = rwmetrop(logpost, proposal, start, nmcmc, data)
dimnames(s$par)[[2]] = c("beta0", "scale", "beta1")

mcmc = mcmc(s$par[-c(1:burn_in),])

diag = geweke.diag(mcmc)

if ((1-pnorm(diag$z[1]) <= 0.05)) stop("Convergence issue")
if ((1-pnorm(diag$z[2]) <= 0.05)) stop("Convergence issue")
if ((1-pnorm(diag$z[3]) <= 0.05)) stop("Convergence issue")

cpt <- function(beta, scale)
{
  n = length(beta)
  res = numeric(n)

  fun <- function(i, beta, scale, n) res <- ifelse(exp(-beta/scale) < hr_limit, 1, 0)

  res = sapply(X = 1, FUN = fun, beta = beta, scale = scale, n = n)
  z = sum(res)/length(beta)

  return(z)
}

prop = cpt(beta = mcmc[,3], scale = mcmc[,2])

post_mean = apply(mcmc, 2, mean)
b_beta0 = post_mean[1]
b_scale = post_mean[2]
b_beta1 = -post_mean[3] / b_scale

post_sds = apply(mcmc, 2, sd)
b_beta1_sd = post_sds[3] / b_scale

cred_int = apply(mcmc, 2, quantile, c(prob_limit, 1-prob_limit))
beta_CI = -cred_int[,3]/b_scale

pool[,j] = c(b_beta0, b_scale, b_beta1, b_beta1_sd, beta_CI, prop)

j <- j + 1
}

bw_beta0[,i] = pool[1,]
bw_scale[,i] = pool[2,]
bw_beta1[,i] = pool[3,]
bw_beta1_sd[,i] = pool[4,]
bw_beta1_sup[,i] = pool[5,]
bw_beta1_inf[,i] = pool[6,]
proportion[,i] = pool[7,]

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```
    i <- i + 1
  }

  return(list(beta1 = bw_beta1, beta1_sd = bw_beta1_sd, beta1_inf = bw_beta1_inf, beta1_sup =
bw_beta1_sup, beta0 = bw_beta0, scale = bw_scale, prop = proportion))
}

bay_res = bay_weibull(theta = theta, data = data_all, hr_hist = 0.786, sd_hist = 0.1103,
  w = c(0), a0 = c(0), hr_limit = 1, prob_limit = 0.10, nmcmc = 25000, burn_in = 5000)
```