

# GenePair: Statistical Methods for Modeling Spatially-Referenced Paired Genetic Relatedness Data

## Patristic\_\_Example

[1] Simulate data from the proposed model:

- Setting the reproducibility seed and initializing packages for data simulation:

```
set.seed(9722)

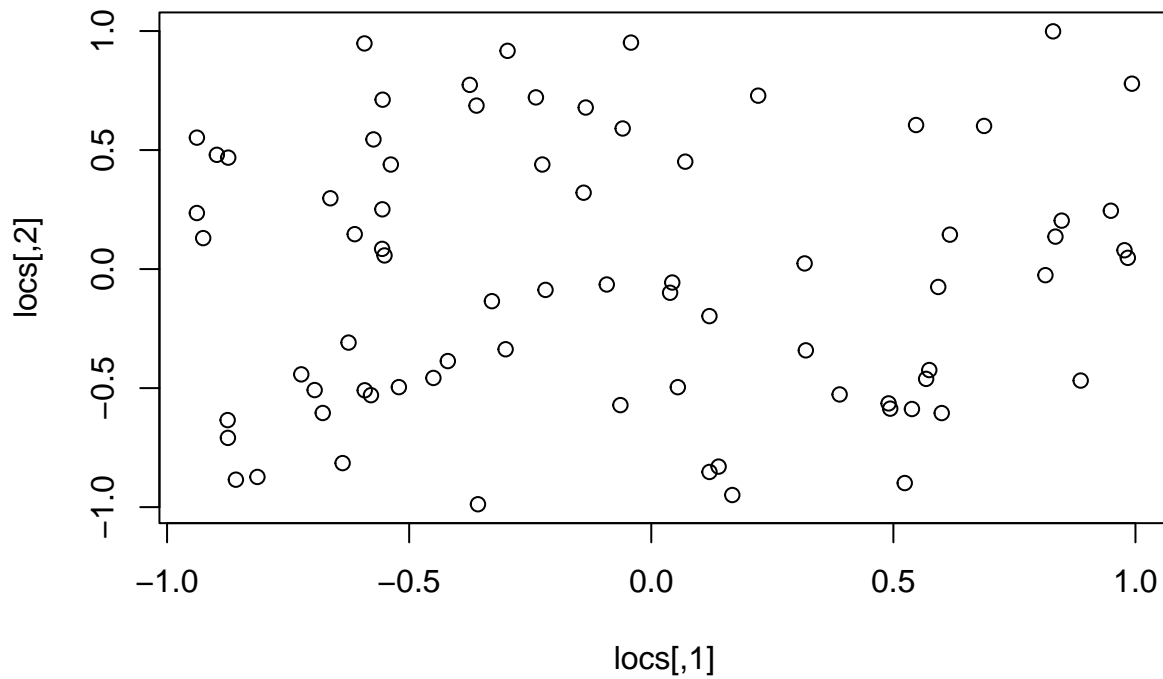
library(GenePair)
library(mnormt) #Multivariate normal distribution
```

- Setting the global data values:

```
n<-75 #Number of individuals
n_star<-0 #Number of paired responses
for(j in 1:(n - 1)){
  for(k in (j + 1):n){
    n_star<-n_star +
      1
  }
}

locs<-matrix(runif((2*n),
                  min = -1.00,
                  max = 1.00), #m=n
            , nrow = n,
            ncol = 2)

plot(locs)
```



```

v<-diag(n)

spatial_dists<-as.matrix(dist(locs,
                              diag = TRUE,
                              upper = TRUE))

#x_pair
x_pair<-matrix(1,
               nrow = n_star,
               ncol = 2)
x_pair[,2]<-rnorm(n = n_star)
x_pair[,2]<-scale(x_pair[,2])

#x_ind
x1<-rnorm(n = n)
x2<-rnorm(n = n)
x3<-rnorm(n = n)
x_ind<-matrix(1,
               nrow = n_star,
               ncol = 3)
counter<-1
for(j in 1:(n - 1)){
  for(k in (j + 1):n){

    x_ind[counter, 1]<-abs(x1[j] - x1[k])
    x_ind[counter, 2]<-abs(x2[j] - x2[k])
  }
}

```

```

    x_ind[counter, 3]<-abs(x3[j] - x3[k])
    counter<-counter +
      1

  }
}
x_ind<-scale(x_ind)

#z
z<-matrix(0,
          nrow = n_star,
          ncol = n)
counter<-1
for(j in 1:(n - 1)){
  for(k in (j + 1):n){

    z[counter, j]<-1
    z[counter, k]<-1
    counter<-counter +
      1

  }
}

```

- Setting the values for the statistical model parameters:

```

beta_true<- c(1.00,
              -0.30)
gamma_true<-c(2.10,
              -1.75,
              0.00)

tau2_true<-2.00
sigma2_zeta_true<-0.01

phi_true<-5.00
Sigma_true<-tau2_true*exp(-phi_true*spatial_dists)
eta_true<-rmnorm(n = 1,
                mean = rep(0.00,
                          times = n),
                varcov = Sigma_true)
eta_true<-eta_true -
  mean(eta_true)
theta_true<-eta_true +
  rnorm(n = n,
        mean = 0.00,
        sd = sqrt(sigma2_zeta_true))

mu_true<-x_pair%%beta_true +
  x_ind%%gamma_true +
  z%%theta_true

sigma2_epsilon_true<-0.10
y<-mu_true +

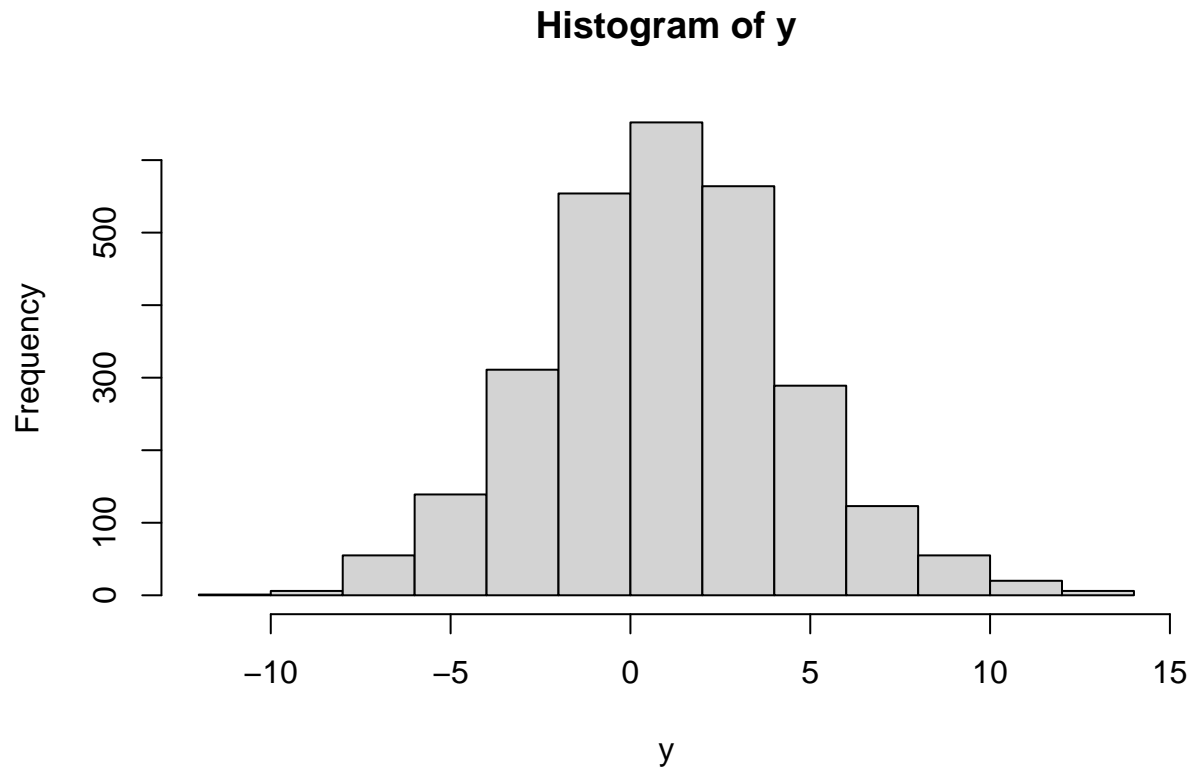
```

```

rnorm(n = n_star,
      mean = 0.00,
      sd = sqrt(sigma2_epsilon_true))

hist(y)

```



[2] Apply the Patristic Function within the GenePair Package:

```

results<-Patristic(mcmc_samples = 50000,
                  y = y,
                  x_pair = x_pair,
                  x_ind = x_ind,
                  z = z,
                  spatial_dists = spatial_dists,
                  v = v,
                  metrop_var_phi_trans = 0.75)

```

```

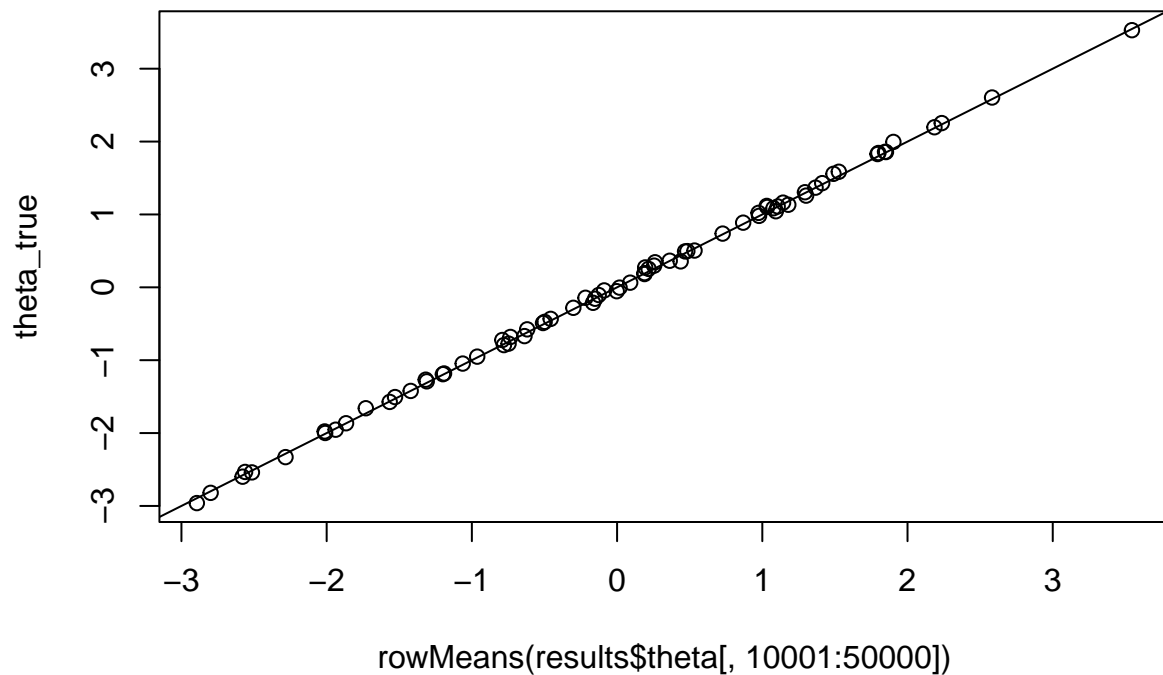
## Progress: 10%
## phi Acceptance: 25%
## *****
## Progress: 20%
## phi Acceptance: 26%
## *****
## Progress: 30%
## phi Acceptance: 25%
## *****
## Progress: 40%

```

```
## phi Acceptance: 25%
## *****
## Progress: 50%
## phi Acceptance: 25%
## *****
## Progress: 60%
## phi Acceptance: 25%
## *****
## Progress: 70%
## phi Acceptance: 25%
## *****
## Progress: 80%
## phi Acceptance: 25%
## *****
## Progress: 90%
## phi Acceptance: 25%
## *****
## Progress: 100%
## phi Acceptance: 25%
## *****
```

[3] Analyzing Output:

```
#Compare random effects
plot(rowMeans(results$theta[,10001:50000]),
      theta_true)
abline(0,1)
```



```

#Compare \beta
round(rowMeans(results$beta[,10001:50000]), 2)

## [1] 1.03 -0.29
round(beta_true, 2)

## [1] 1.0 -0.3

#Compare \gamma
round(rowMeans(results$gamma[,10001:50000]), 2)

## [1] 2.10 -1.76 0.00
round(gamma_true, 2)

## [1] 2.10 -1.75 0.00

#Compare \sigma2_epsilon
round(mean(results$sigma2_epsilon[10001:50000]), 2)

## [1] 0.1
sigma2_epsilon_true

## [1] 0.1

```