

# 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<-100 #Number of individuals
```

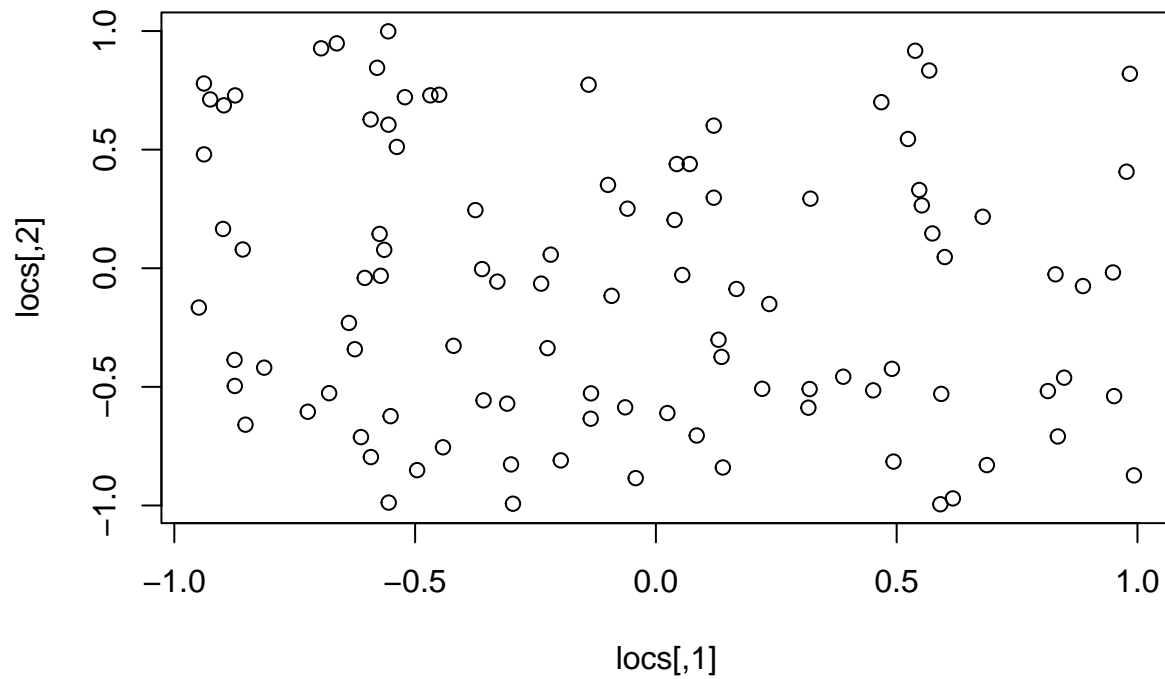
```
n_star<-0 #Number of paired responses
```

```
for(j in 1:(n - 1)){  
  for(k in (j + 1):n){  
    n_star<-n_star +  
      1  
  }  
}
```

```
#Unique locations (one for each individual)
```

```
locs<-matrix(runif((2*n),  
                  min = -1.00,  
                  max = 1.00),  
             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)

theta_true<-eta_true +
  rnorm(n = n,
        mean = 0.00,
        sd = sqrt(sigma2_zeta_true))
theta_true<-theta_true -
  mean(theta_true)

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

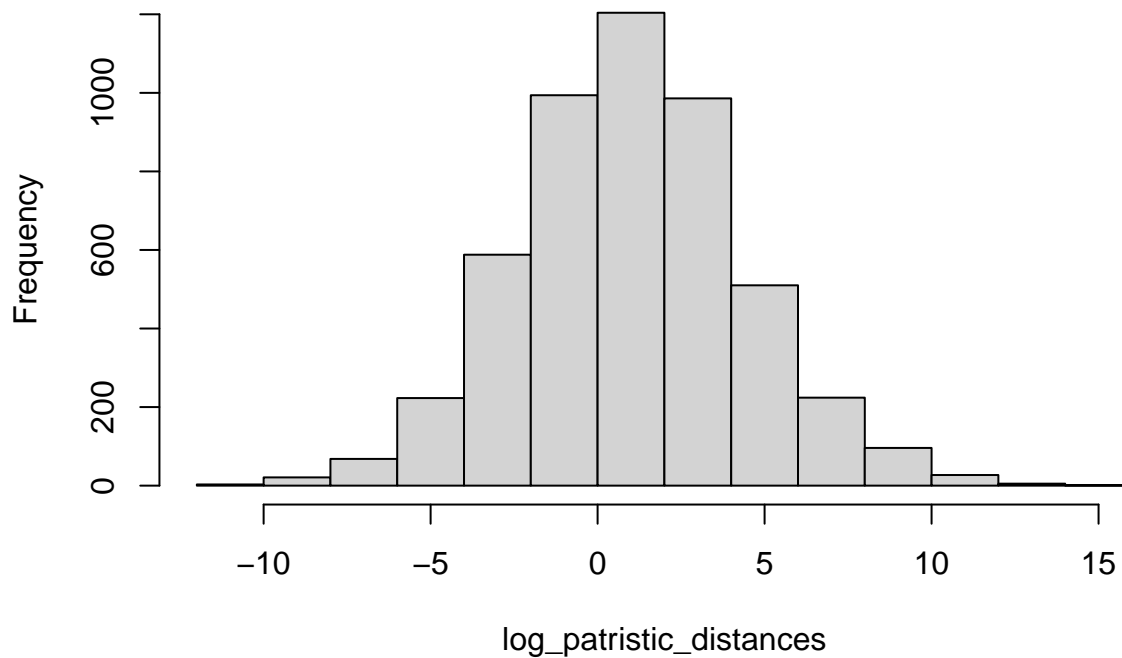
sigma2_epsilon_true<-0.10

```

```
log_patristic_distances<-mu_true +
  rnorm(n = n_star,
        mean = 0.00,
        sd = sqrt(sigma2_epsilon_true))

hist(log_patristic_distances)
```

**Histogram of log\_patristic\_distances**



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

```
results<-Patristic(mcmc_samples = 20000,
  log_patristic_distances = log_patristic_distances,
  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: 24%
## *****
## Progress: 30%
## phi Acceptance: 24%
## *****
```

```

## Progress: 40%
## phi Acceptance: 24%
## *****
## Progress: 50%
## phi Acceptance: 24%
## *****
## Progress: 60%
## phi Acceptance: 24%
## *****
## Progress: 70%
## phi Acceptance: 24%
## *****
## Progress: 80%
## phi Acceptance: 24%
## *****
## Progress: 90%
## phi Acceptance: 24%
## *****
## Progress: 100%
## phi Acceptance: 24%
## *****

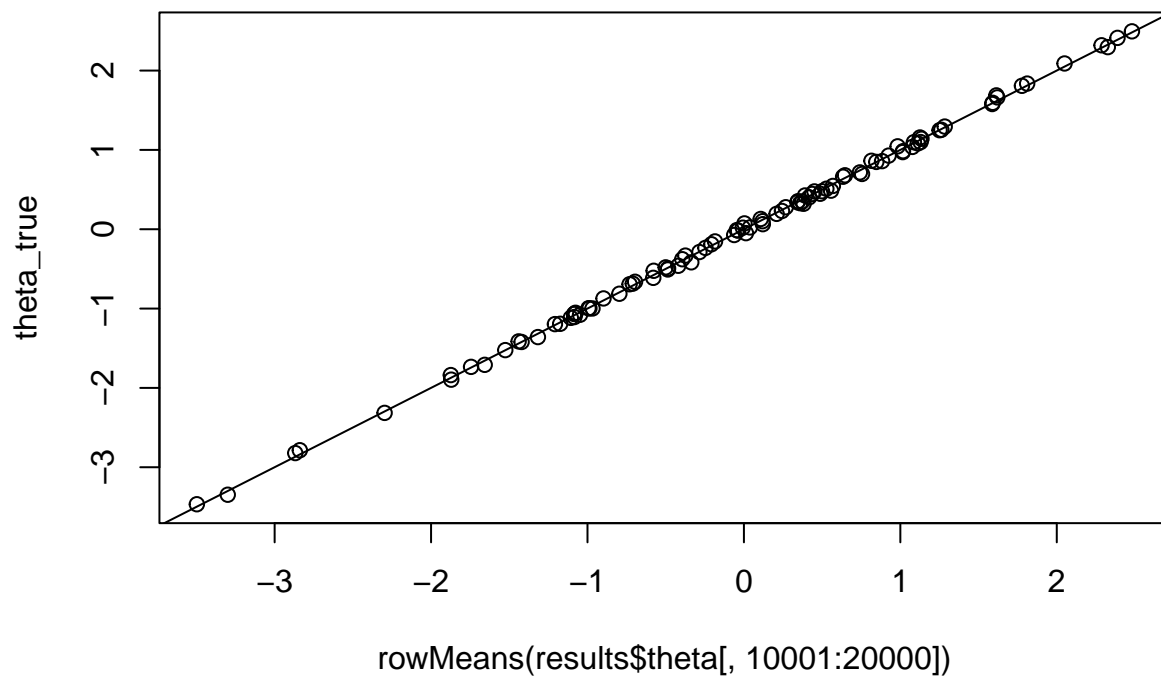
```

[3] Analyzing Output:

```

#Compare random effects
plot(rowMeans(results$theta[,10001:20000]),
      theta_true)
abline(0,1)

```



```
#Compare \beta
round(rowMeans(results$beta[,10001:20000]), 2)

## [1] 0.99 -0.29
round(beta_true, 2)

## [1] 1.0 -0.3

#Compare \gamma
round(rowMeans(results$gamma[,10001:20000]), 2)

## [1] 2.11 -1.75 0.00
round(gamma_true, 2)

## [1] 2.10 -1.75 0.00

#Compare \sigma^2_\epsilon
round(mean(results$sigma2_epsilon[10001:20000]), 2)

## [1] 0.1
sigma2_epsilon_true

## [1] 0.1
```