

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

SNP_Example

[1] Simulate data from the proposed model:

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

```
set.seed(5445)

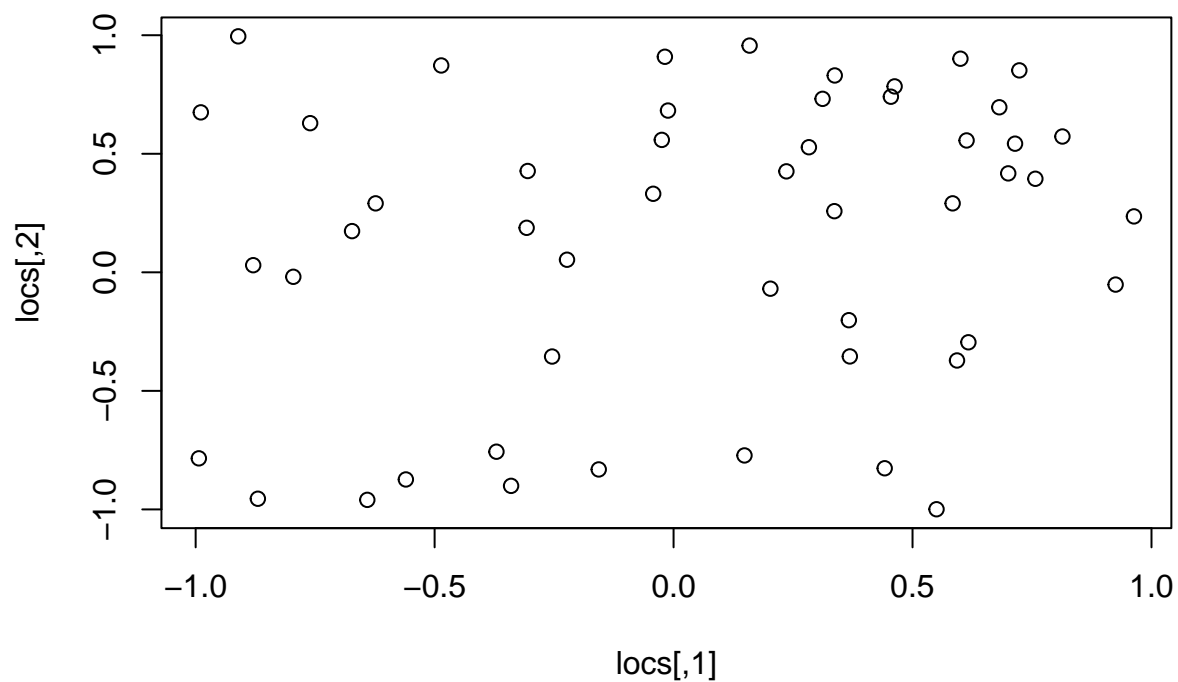
library(GenePair)
library(mnormt) #Multivariate normal distribution
```

- Setting the global data values:

```
n<-50 #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)
x1<-rnorm(n = n)
x2<-rnorm(n = n)
counter<-1
for(j in 1:(n - 1)){
  for(k in (j + 1):n){

    x_pair[counter, 2]<-abs(x1[j] - x2[k])
    counter<-counter +
      1

  }
}
x_pair[,2]<-scale(x_pair[,2])

#x_ind
x1<-rnorm(n = n)
```

```

x2<-rnorm(n = n)
x_ind<-matrix(0.00,
              nrow = n_star,
              ncol = 2)
counter<-1
for(j in 1:(n - 1)){
  for(k in (j + 1):n){

    x_ind[counter, 1]<-(x1[k] + x1[j])
    x_ind[counter, 2]<-(x2[k] + x2[j])
    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(0.10,
              -0.25)

tau2_true<-0.25
sigma2_zeta_true<-0.10

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))

```

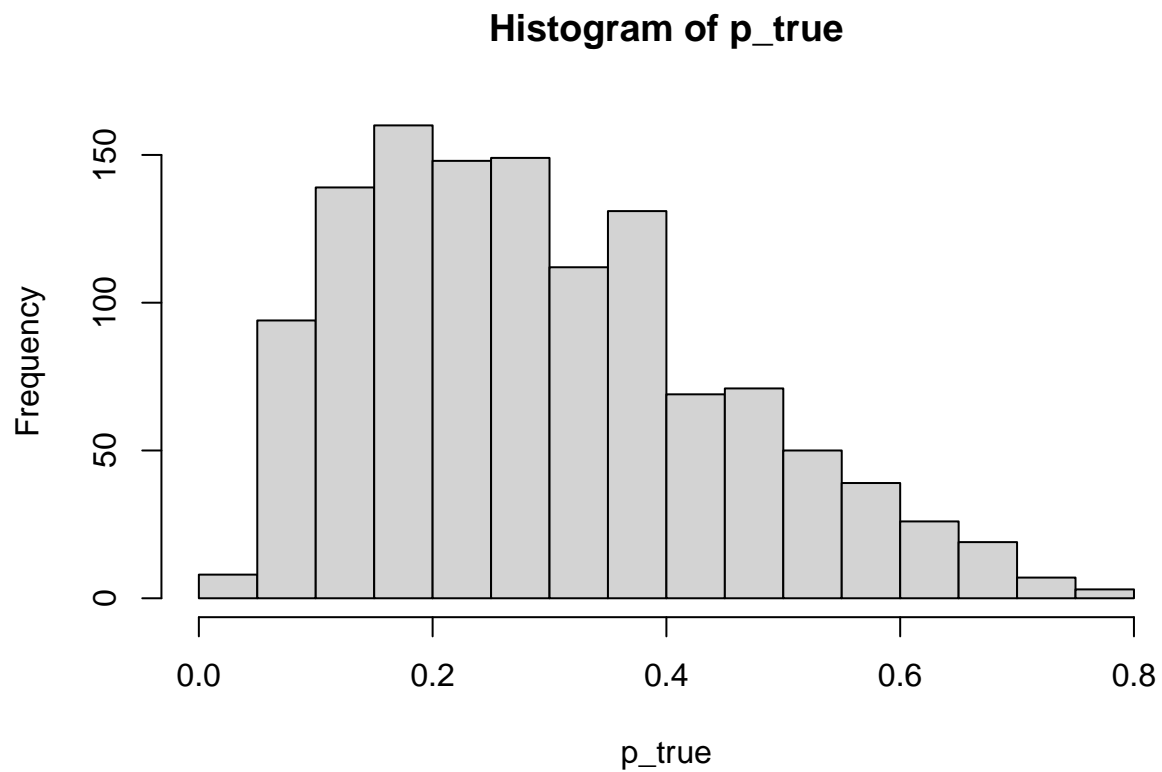
```

theta_true<-theta_true -
  mean(theta_true)

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

p_true<-1.00/(1.00 + exp(-mu_true))
hist(p_true)

```



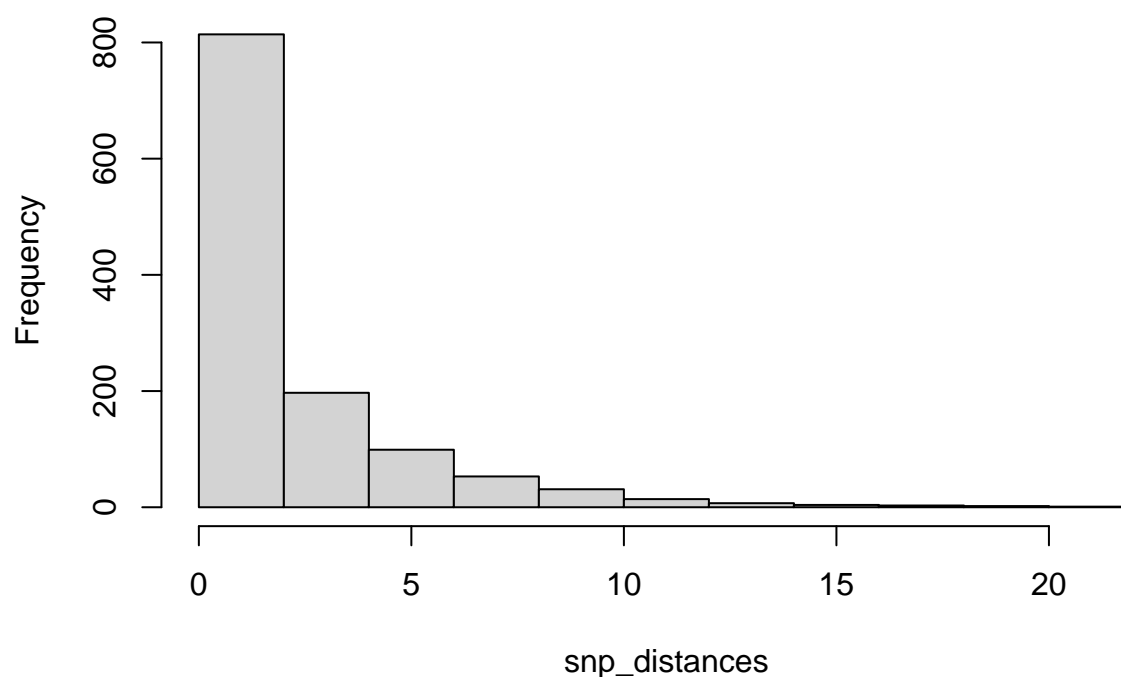
```

r_true<-5
snp_distances<-rbinom(n = n_star,
  size = r_true,
  prob = (1.00 - p_true))

hist(snp_distances)

```

Histogram of snp_distances



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

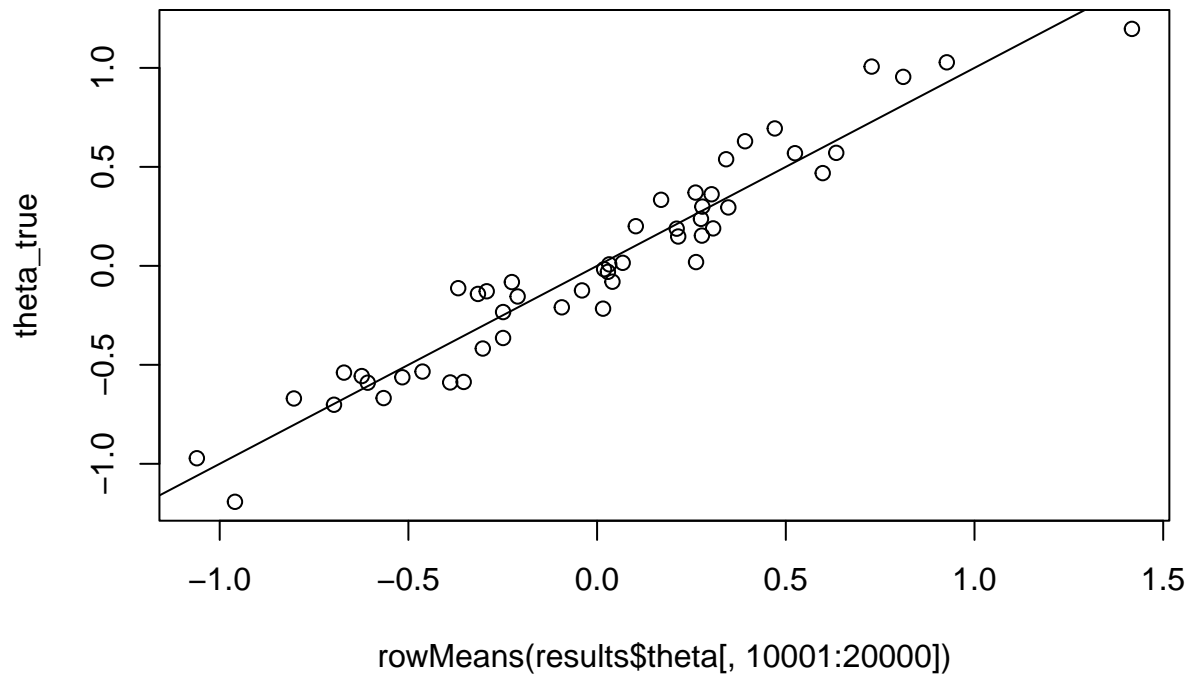
```
results<-SNP(mcmc_samples = 20000,
             snp_distances = snp_distances,
             x_pair = x_pair,
             x_ind = x_ind,
             z = z,
             spatial_dists = spatial_dists,
             v = v,
             metrop_var_phi_trans = 0.75)
```

```
## Progress: 10%
## phi Acceptance: 33%
## *****
## Progress: 20%
## phi Acceptance: 32%
## *****
## Progress: 30%
## phi Acceptance: 32%
## *****
## Progress: 40%
## phi Acceptance: 31%
## *****
## Progress: 50%
## phi Acceptance: 31%
## *****
## Progress: 60%
```

```
## phi Acceptance: 31%
## *****
## Progress: 70%
## phi Acceptance: 31%
## *****
## Progress: 80%
## phi Acceptance: 31%
## *****
## Progress: 90%
## phi Acceptance: 31%
## *****
## Progress: 100%
## phi Acceptance: 31%
## *****
```

[3] Analyzing Output:

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



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

```
## [1] -0.33
```

```

round(beta_true[2], 2)

## [1] -0.3

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

## [1] 0.15 -0.13

round(gamma_true, 2)

## [1] 0.10 -0.25

#Compare r
hist(results$r[10001:20000])
abline(v = r_true,
       col = "red")

```

