Permutation test on Spearman functional correlation coefficient

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First, Icreate the two functional data

Utils

```r
diagnostic_permutation <- function(T20, T2) {
  B <- length(T2)

  # Compare real test statistic with the ones given by the permuted data
  hist(T2, xlim = range(c(T2, T20)))
  abline(v = T20, col = 3, lwd = 4)

  # Empirical cumulative distribution function
  plot(ecdf(T2),main="ECDF(T2)")
  abline(v = T20, col = 3, lwd = 4)

  # P-value
  p_val <- sum(T2 >= T20) / B
  cat("p-value: ", p_val)
}

compute_t_stat <- function(df1, df2,grid) {
  df1_f<- roahd::fData(grid,df1)
  df2_f<- roahd::fData(grid,df2)
  bivariate_data <-roahd::as.mfData(list(df1_f, df2_f))
  spearman_f<-roahd::cor_spearman(bivariate_data, ordering='MHI')
  return(abs(spearman_f))
}
```

Now I compute the Spearmann functional correlation coefficient

```r
# observed test statistics
df1<-Prev_m_table
df2<-Prev_f_table
T20 = compute_t_stat(df1, df2,grid)
T20
```

```
## [1] 0.5416701
```

My T0 is 0.54, indicating moderate positive correlation

```r
perm_wrapper = function(df1,df2,grid) {
  df_pooled = rbind(df1, df2)
  n = nrow(df_pooled)
```

```
  n1 = nrow(df1)
  permutation = sample(n)
  df_perm = df_pooled[permutation, ]
  df1_perm = df_perm[1:n1, ]
  df2_perm = df_perm[(n1 + 1):n, ]
  compute_t_stat(df1_perm, df2_perm,grid)
}

seed=2022
B=1000
n_cores <- detectCores()
cl = makeCluster(n_cores)
invisible(clusterEvalQ(cl, library(DepthProc)))
clusterExport(cl, varlist = list("perm_wrapper", "df1", "df2", "grid", "compute_t_stat"))
set.seed(seed)
T2 <- pbreplicate(10000, perm_wrapper(df1, df2, grid), cl = cl)
stopCluster(cl)
```
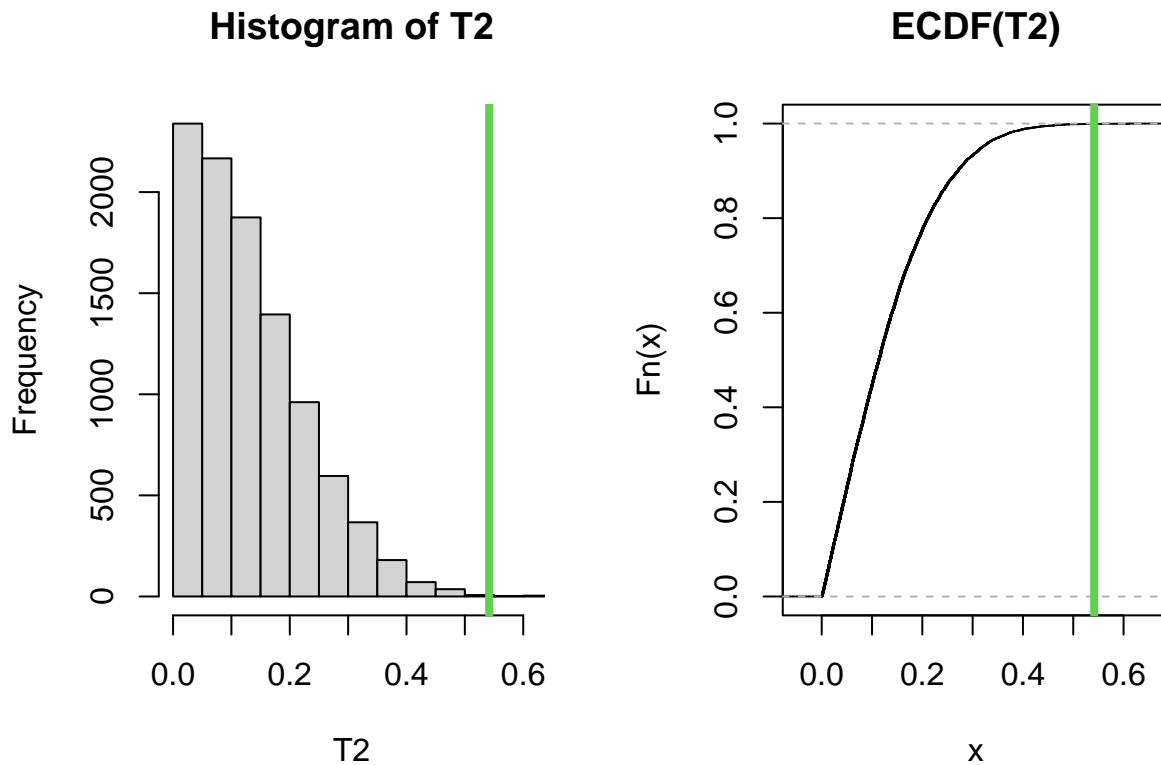
```
par(mfrow=c(1,2))
diagnostic_permutation(T20,T2)
```


Histogram of T2   **ECDF(T2)**

```
## p-value:  6e-04
```

P-value is 0, hence I can reject the null hypothesis of no functional correlation