

Appendix Text

1. Copula Entropy Code

```
#drawing library(copent)
setwd("E:/study/study materials/thesis/material") library(xlsx)
x1 = read.xlsx("E:/study/study material/thesis/material/all data collective version.xlsx",sheetIndex = 1, header = TRUE)
View(x1)
xc1 = construct_empirical_copula(x1) data = list(x = x1, xc = xc1)
dat <- as.data.frame(do.call(rbind,data)) dat$type <- rep(c('x','xc'),each = 16)
foo.upper <- function(x,y,...) {
  points(x[dat$type == 'x'],y[dat$type == 'x'],col = 'red',...)
}
foo.lower <- function(x,y,...) { plot.window(xlim = c(0,1), ylim = c(0,1))
  points(x[dat$type == 'xc'],y[dat$type == 'xc'],col = 'blue',...)
}
pairs(dat[,-13],lower.panel = foo.lower,upper.panel = foo.upper)
#Relevance library(copent)
setwd("E:/study/study materials/thesis/material") library(xlsx)
x1 = read.xlsx("E:/study/study materials/thesis/material/economics+education.xlsx",sheetIndex = 1, header = TRUE)
View(x1)
xc1 = construct_empirical_copula(x1) data = list(x = x1, xc = xc1)
dat <- as.data.frame(do.call(rbind,data)) dat$type <- rep(c('x','xc'),each = 16)
foo.upper <- function(x,y,...) {
  points(x[dat$type == 'x'],y[dat$type == 'x'],col = 'red',...)
}
foo.lower <- function(x,y,...) { plot.window(xlim = c(0,1), ylim = c(0,1))
  points(x[dat$type == 'xc'],y[dat$type == 'xc'],col = 'blue',...)
}
pairs(dat[,-11],lower.panel = foo.lower,upper.panel = foo.upper) entknn(xc1)
rho = 0.75
truevalue = -0.5 * log(1- rho^2) est = copent(x1)
```

```

#Causality library(copent)
setwd("E:/study/study materials/thesis/material") library(xlsx)
x1 = read.xlsx("E:/study/study materials/thesis/material/economics+education6.xlsx",sheetIndex = 1, header = TRUE)
tslag = 0
for (lag in 1:12){
edu1 = x1[1:(16-lag),1] edu2 = x1[(lag+1):16,1] var1 = x1[1:(16-lag),2]
data1 = cbind(edu1, edu2, var1)
tslag[lag] = copent(data1) - copent(data1[,c(1,2)]) - copent(data1[,c(1,3)])
}
plot(tslag, xlab = "lag (years)", ylab = "Transfer Entropy", main = "GDP of regional GDP + number of graduate students in higher education")
lines(tslag) library(copent)
setwd("E:/study/study materials/thesis/material") library(xlsx)
x1 = read.xlsx("E:/study/study material/thesis/material/economics+education5.xlsx",sheetIndex = 1, header = TRUE)
tslag = 0
for (lag in 1:12){
edu1 = x1[1:(16-lag),1] edu2 = x1[(lag+1):16,1] var1 = x1[1:(16-lag),2]
data1 = cbind(edu1, edu2, var1)
tslag[lag] = copent(data1) - copent(data1[,c(1,2)]) - copent(data1[,c(1,3)])
}
plot(tslag, xlab = "lag (years)", ylab = "Transfer Entropy", main = "GDP of regional GDP + number of general higher education institutions")
lines(tslag)

```

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2023.53.008468

Bin Zhao. Biomed J Sci & Tech Res



This work is licensed under Creative Commons Attribution 4.0 License

Submission Link: <https://biomedres.us/submit-manuscript.php>



Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles

<https://biomedres.us/>