Homework #01

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* Data:

1. Copepod\_composition: Proportion of each copepod species recorded in each station and season (p=spring, s=summer, w=winter)

%p1 p3 p4 p6 p13 p16 p19 p21 p23 p25 s18 s19 s20 s22 s23 s25 s27 s29 sA sB sC sD sE sF sG w22 w23 w25 w27 w29 wA wB wC wD0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.42 0 0 0 00 0 0 0 0 0.22 2.34 0 2.51 1.62 0 0 0 0 0 0 1.52 0.3 3.06 1.35 1.24 0.62 2.92 0.31 1.4 0 0 0 0 0 0 2.22 1.13 0.93

1. Cop\_density: copepod total density (number/m3) recorded in each station

1119115317198551246212311591497135196029461900150840434919

1. copepodSPlist: Species name

Acartia bifilosaAcartia erythraeaAcartia negligenceAcartia omoriAcartia pacificaAcartia spAetideidae sp1Aetideidae sp2Aetideidae sp3Aetideidae copepodidMetacalanus auvivilliiHaloptilus spCalanoides carinatusCalanus sinicusCanthocalanus pauperCosmocalanus darwiniiMesocalanus tenuicornis

* Results:

1. Copepod density for each species for each cruise-station:

Row names are the species names, and columns names are the cruise-stations

## 1 3 4 6 13 16 19 21 23 25 18

## Acartia bifilosa 0 0 0 0 0 0.0000 0.0000 0 0.0000 18.99600 0.0000

## Acartia erythraea 0 0 0 0 0 0.0000 0.0000 0 0.0000 0.00000 0.0000

## Acartia negligence 0 0 0 0 0 4.6706 27.1206 0 33.9101 15.55200 0.0000

## Acartia omori 0 0 0 0 0 0.0000 0.0000 0 0.0000 0.00000 0.0000

## Acartia pacifica 0 0 0 0 0 0.0000 29.6400 0 553.1204 96.61363 119.9022

## Acartia sp 0 0 0 0 0 0.0000 0.0000 0 0.0000 0.00000 0.0000

## 20 22 27 29 A B

## Acartia bifilosa 0.0000 0.0000 0.00000 0.000000 0.00000 0.00000

## Acartia erythraea 0.0000 0.0000 0.00000 0.175308 0.00000 0.00000

## Acartia negligence 0.0000 0.0000 31.93520 14.469000 48.59280 40.18584

## Acartia omori 0.0000 0.0000 0.00000 0.000000 4.12880 0.00000

## Acartia pacifica 16.2864 264.8199 1.77331 2.621272 4.17973 0.13916

## Acartia sp 0.0000 0.0000 15.96760 72.827300 0.00000 0.00000

## C D E F G

## Acartia bifilosa 0.00000 0.000000 0.0000 0.0000 0.00

## Acartia erythraea 0.00000 0.000000 0.0000 0.0000 0.00

## Acartia negligence 48.27886 8.828831 160.3664 24.5458 17.78

## Acartia omori 0.00000 0.000000 0.0000 0.0000 0.00

## Acartia pacifica 0.00000 0.289354 17.5744 121.1454 0.00

## Acartia sp 0.00000 0.000000 0.0000 0.0000 0.00

1. Species richness and Shannon diversity index:
2. Species richness for each cruise-station:

## colSums.sp\_rich.df.

## 1 6

## 3 12

## 4 8

## 6 9

## 13 31

## 16 29

## 19 65

## 21 7

## 23 66

## 25 68

## 18 39

## 20 32

## 22 33

## 27 60

## 29 39

## A 76

## B 83

## C 79

## D 72

## E 44

## F 38

## G 25

1. Shannon diversity index for each cruise-station:

## Shannon index

## 1 1.080782

## 3 1.256126

## 4 1.045406

## 6 1.114551

## 13 2.144528

## 16 1.413396

## 19 4.595925

## 21 1.566761

## 23 5.902687

## 25 5.414535

## 18 2.841237

## 20 2.568974

## 22 4.003199

## 27 4.900656

## 29 3.988412

## A 5.273402

## B 5.252945

## C 5.349971

## D 5.261798

## E 3.020831

## F 2.890280

## G 1.692271

1. Dominant species’ average density by seasons:

## spring\_mean summer\_mean winter\_mean

## Acartia pacifica 0.00000 67.728267 23.57568900

## Calanus sinicus 86.46599 2.500233 4.60278089

## Canthocalanus pauper 3.42582 204.692020 1.26660244

## Clausocalanus furcatus 11.92657 63.691307 0.67185067

## Clausocalanus minor 11.44634 23.415760 0.68068656

## Subeucalanus pileatus 0.00000 28.013247 0.86376644

## Subeucalanus copepodid 4.87340 40.484947 0.22946133

## Euchaeta copepodid 28.35273 41.598293 23.15445778

## Acrocalanus gibber 10.71096 156.406840 0.99605678

## Calocalanus pavoninus 1.45908 26.636913 0.00000000

## Paracalanus aculeatus 54.09300 18.917167 9.39986078

## Paracalanus pavus 626.17119 414.204633 18.13617244

## Paracalanus serrulus 0.00000 107.269380 0.02491267

## Parvocalanus crassirostris 11.22283 419.718387 0.03758444

## Scolecithricella longispinosa 0.76840 20.457953 4.46338178

## Temora turbinata 3.69089 267.764627 0.97009244

## Oithona attenuata 0.47348 134.511173 0.00000000

## Oithona brevicornis 0.23674 53.421613 0.00000000

## Oithona plumifera 28.78133 83.105013 0.99051589

## Oithona similis 115.08926 38.426887 0.00000000

## Euterpina acutifrons 7.36190 197.810427 0.00000000

## Corycaeus (Ditrichocorycaeus) affinis 161.22854 6.445867 0.00000000

## Corycaeus (Ditrichocorycaeus) dahli 1.75298 97.267093 0.08584778

## Corycaeus (Ditrichocorycaeus) lubbocki 0.00000 75.731147 1.56444311

## Corycaeidae copepodid 21.42939 0.000000 0.00000000

## Oncaea conifera 1.12309 116.335620 0.95004678

## Oncaea venusta 33.96802 341.826987 1.25436611

* Codes:

#read table

setwd("C:/Users/dan91/Rstudio/stat\_data/mock\_dataTS")

cop\_compo <- read.table("Copepod\_composition.txt", header = T)

cop\_den <- read.table("Cop\_density.txt")

cop\_sp <- read.table("copepodSPlist.txt", fill = T, sep = "\n") #separate by different row

# 1. Calculate the copepod density for each species for each cruise-station

colnames(cop\_compo) <- c("1", "3", "4", "6", "13", "16", "19a", "21", "23a", "25a", "18", "19b", "20", "22a", "23b", "25b", "27a", "29a", "Aa", "Ba", "Ca", "Da", "E", "F", "G", "22b", "23c", "25c", "27b", "29b", "Ab", "Bb", "Cb", "Db")

head(cop\_compo)

rownames(cop\_den) <- colnames(cop\_compo)

head(cop\_den)

#multiply proportion of composition and density

sp\_den\_cr <- matrix(0, nrow = length(cop\_sp$V1), ncol = length(cop\_den$V1))

for(i in 1:length(cop\_sp$V1)){

for(j in 1:length(cop\_den$V1)){

sp\_den\_cr[i, j] <- cop\_compo[i, j]/100 \* cop\_den[j,]

}

}

sp\_den\_cr.df <- as.data.frame(sp\_den\_cr)

colnames(sp\_den\_cr.df) <- colnames(cop\_compo)

head(sp\_den\_cr.df)

#sum of the same station

sp\_den\_cr.df$`19a` <- sp\_den\_cr.df$`19a` + sp\_den\_cr.df$`19b`

sp\_den\_cr.df$`23a` <- sp\_den\_cr.df$`23a` + sp\_den\_cr.df$`23b` + sp\_den\_cr.df$`23c`

sp\_den\_cr.df$`25a` <- sp\_den\_cr.df$`25a` + sp\_den\_cr.df$`25b` + sp\_den\_cr.df$`25c`

sp\_den\_cr.df$`22a` <- sp\_den\_cr.df$`22a` + sp\_den\_cr.df$`22b`

sp\_den\_cr.df$`27a` <- sp\_den\_cr.df$`27a` + sp\_den\_cr.df$`27b`

sp\_den\_cr.df$`29a` <- sp\_den\_cr.df$`29a` + sp\_den\_cr.df$`29b`

sp\_den\_cr.df$Aa <- sp\_den\_cr.df$Aa + sp\_den\_cr.df$Ab

sp\_den\_cr.df$Ba <- sp\_den\_cr.df$Ba + sp\_den\_cr.df$Bb

sp\_den\_cr.df$Ca <- sp\_den\_cr.df$Ca + sp\_den\_cr.df$Cb

sp\_den\_cr.df$Da <- sp\_den\_cr.df$Da + sp\_den\_cr.df$Db

sp\_den\_cr.df <- sp\_den\_cr.df[, -c(12, 15, 16, 26, 27, 28, 29, 30, 31,32,33,34)]

colnames(sp\_den\_cr.df) <- c("1", "3", "4", "6", "13", "16", "19", "21", "23", "25", "18", "20", "22", "27", "29", "A", "B", "C", "D", "E", "F", "G")

rownames(sp\_den\_cr.df) <- cop\_sp$V1

#species density at each cruise-station

head(sp\_den\_cr.df)

# 2. For each cruise-station, calculate the species richness (number of species) and Shannon diversity index

### 2(1). species richness

sp\_rich <- ifelse(sp\_den\_cr.df > 0, 1, 0)

sp\_rich.df <- as.data.frame(sp\_rich)

#calculate species number at each cruise-station

richness <- data.frame(colSums(sp\_rich.df))

richness

### 2(2). Shannon index

#species proportion at each cruise-station

cop\_compo$`19a` <- cop\_compo$`19a` + cop\_compo$`19b`

cop\_compo$`23a` <- cop\_compo$`23a` + cop\_compo$`23b` + cop\_compo$`23c`

cop\_compo$`25a` <- cop\_compo$`25a` + cop\_compo$`25b` + cop\_compo$`25c`

cop\_compo$`22a` <- cop\_compo$`22a` + cop\_compo$`22b`

cop\_compo$`27a` <- cop\_compo$`27a` + cop\_compo$`27b`

cop\_compo$`29a` <- cop\_compo$`29a` + cop\_compo$`29b`

cop\_compo$Aa <- cop\_compo$Aa + cop\_compo$Ab

cop\_compo$Ba <- cop\_compo$Ba + cop\_compo$Bb

cop\_compo$Ca <- cop\_compo$Ca + cop\_compo$Cb

cop\_compo$Da <- cop\_compo$Da + cop\_compo$Db

cop\_compo <- cop\_compo[, -c(12, 15, 16, 26, 27, 28, 29, 30, 31,32,33,34)]

colnames(cop\_compo) <- c("1", "3", "4", "6", "13", "16", "19", "21", "23", "25", "18", "20", "22", "27", "29", "A", "B", "C", "D", "E", "F", "G")

rownames(cop\_compo) <- cop\_sp$V1

head(cop\_compo)

# calculate the index

shannon\_index <- data.frame(-colSums(cop\_compo/100 \* log(cop\_compo / 100), na.rm = T))

colnames(shannon\_index) <- "Shannon index"

shannon\_index

# 3. For each of the dominant species (species >=5% of total composition in any cruise-station regardless of the seasons), calculate the average density by seasons.

setwd("C:/Users/dan91/Rstudio/stat\_data/mock\_dataTS")

cop\_compo\_season <- read.table("Copepod\_composition.txt", header = T)

sp\_den\_cr\_season <- matrix(0, nrow = length(cop\_sp$V1), ncol = length(cop\_den$V1))

for(i in 1:length(cop\_sp$V1)){

for(j in 1:length(cop\_den$V1)){

sp\_den\_cr\_season[i, j] <- cop\_compo\_season[i, j]/100 \* cop\_den[j,]

}

}

sp\_den\_cr\_season.df <- as.data.frame(sp\_den\_cr\_season)

colnames(sp\_den\_cr\_season.df) <- colnames(cop\_compo\_season)

head(sp\_den\_cr\_season.df)

#find out dominant species

dominant\_sp.df <- data.frame(ifelse(cop\_compo\_season >= 5, 1, 0))

dominant\_species <- rownames(dominant\_sp.df)[rowSums(dominant\_sp.df) >= 1]

as.numeric(dominant\_species)

cop\_sp[dominant\_species,]

#calculate the mean of three seasons respectively

dominant\_sp\_den <- sp\_den\_cr\_season.df[dominant\_species, ]

dominant\_sp\_den$spring\_mean <- rowMeans(dominant\_sp\_den[, 1:10])

dominant\_sp\_den$summer\_mean <- rowMeans(dominant\_sp\_den[, 11:25])

dominant\_sp\_den$winter\_mean <- rowMeans(dominant\_sp\_den[, 26:34])

dominant\_sp\_den\_season <- dominant\_sp\_den[, 35:37]

rownames(dominant\_sp\_den\_season) <- cop\_sp[dominant\_species,]

dominant\_sp\_den\_season