ESA Workshop

8 August, 2016

Initial Setup

```
# Set working environment
rm(list = ls())
setwd("~/GitHub/ltermetacommunities/ESA_2016/")

# Check for and install required packages
for (package in c('dplyr', 'tidyr', 'vegetarian', 'vegan', 'metacom')) {
  if (!require(package, character.only=T, quietly=T)) {
    install.packages(package)
    library(package, character.only=T)
  }
}
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
## This is vegan 2.4-0
```

Dataset: NWT Plant Communities

Brief background on dataset?

```
# Read in NWT plant community data and site coordinates
nwt.xy <- read.csv("NWT_coordinates.csv")
nwt.comm.long <- read.csv("NWT_plantcomp.csv")[,c(2,4,5,6)]
dim(nwt.comm.long)
```

```
## [1] 19910     4
```

```
# Convert to wide format
nwt.comm.wide <- tidyr::spread(nwt.comm.long,
                               USDA_code, abund,
                               fill = 0)
dim(nwt.comm.wide)
```

```
## [1] 968 111
```

Three analyses for metacommunity time series datasets:

1) Diversity Partitioning [Jost, 2007]

2) Variation Partitioning [Borcard et al., 1992, Legendre et al., 2005]

3) Elements of Metacommunity Structure [Leibold and Mikkelson, 2002, Presley et al., 2010]

Diversity Paritioning

Variation Partitioning

Elements of Metacommunity Structure

```
# First, we'll test on an individual year
nwt.1989 <- filter(nwt.comm.wide, year == 1989)
head(nwt.1989)
```

```
##   plot year 2COMP 2FORB 2GENT 2GRAM 2LICHN 2MOSS 2UNK ALGE ANME2 ANRO2
## 1    1 1989     0     0     0     0     20     0    0    0     0     0
## 2    2 1989     0     0     0     0      1     0    0    0     0     0
## 3    3 1989     0     0     0     0      0     0    0    0     0     0
## 4    4 1989     0     0     0     0     10     0    0    0     0     0
## 5    5 1989     0     1     0     0      1     0    0    0     0     0
## 6    6 1989     0     0     0     0      0     0    0    0     0     0
##   ANSE4 ARFEF3 ARPA18 ARSC CAAL6 CACA12 CACA13 CAEL3 CAHA6 CAHEE CALA10
## 1     0      0      0    0     0      0      0     0     0     0      0
## 2     0      0      0    0     0      0      0     0     0     0      0
## 3     0      0      0    0     0      0      0     0     0     2      0
## 4     0      0      0    9     0      0      0     0     0     0      0
## 5     0      0      0    2     0      0      0     0     0     0      0
## 6     0      0      0    3     0      0      0     0     0     0      0
##   CALE4 CAMPA CANI2 CAOC4 CAPE12 CAPH2 CAPU CAPY3 CAREX CARO2 CARUD CASCS2
## 1     0     0     0     0      0     0    0     0     0     0     0      0
## 2     0     0     0     0      0     0    0     0     0     0     0      0
## 3     0     0     0     0      0     0    0     0     0     0     0     10
## 4     1     0     0     8      0     0    0     0     0     0     0      0
## 5     0     0     0     0      0     0    0     0     0     0     0      0
## 6     0     0     0     1      0     0    0     0     0     0     0      0
##   CAUN2 CEARS2 CERAS CHANA2 CHJA DECE DRABA DRAU DRBRC DRST4 ELTRT EPAN4
## 1     0      0     0      0    0    0     0    0     0     0     0     0
## 2     0      0     0      0    0   15     0    0     0     0     0     0
## 3     0      0     0      0    0    0     0    0     0     0     0     0
## 4     0      0     0      0    2   23     0    0     0     0     0     0
## 5     0      0     0      0    0   36     0    0     0     0     0     0
## 6     0      0     0      0    0    4     0    0     0     0     0     0
##   ERCA14 ERIGE2 ERME2 ERNA ERPI6 ERSI3 FEBR GEAL2 GEAMA GEROT HEMO3 JUDR
## 1      0      0     0    0     0     0    0     0     0     0     0    0
## 2      0      0     0    0     0     0    1     0     0    46     0    0
## 3      0      0     0    0     0     0    0     0     0    94     0    0
## 4      0      0     0    0     0     4    3     0     0    22     0    0
## 5      0      0     0    0     0     3    1     0     0     6     0    0
## 6      0      0     0    0     0     2    0     0     0    18     0    0
##   KOMY LEPY2 LLSE LUSP4 MELA3 MEOB MIOB2 MIRU3 NOMO2 ORALA OXDI3 PACA15
## 1    0     0    0     0     0    0     0     0     0     0     0      0
## 2    0     0    0     0     0    0     0     0     0     0     0      0
## 3    0     0    0     0    13    0     0     0     0     0     0      0
## 4    0     1    0     0     0    0     2     0     0     0     0      0
```

```
## 5    0     0    0     0     0    0     3     0     0     0     0      0
## 6    0     0    0     0     0    0     1     0     0     0     0      0
##   PACR5 PAPU2 PEGR2 PHAL2 PHPU5 POA POAL2 POARG POBI6 PODI2 POGLR2 POTEN
## 1     0     0     0     0     0   0     0     0     0     0      0     0
## 2     0     0     0     0     0   0     0     0    10     0      0     0
## 3     0     0     0     0     0   0     0     0     2     1      0     0
## 4     0     0     0     0     0   0     0     0     6     0      0     0
## 5     0     0     0     0     0   0     0     0     5     0      0     0
## 6     0     0     0     0     0   0     0     0     4     0      0     0
##   POVI POVI3 PRAN PRPA RAAD RHIN11 RHRH4 SAGL SANI8 SAPE18 SAPL2 SARH2
## 1    0     0    0    0    0      0     0    0     0      0     0     0
## 2    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
## 4    0     0    0    0    1      0     0    0     0      0     0     0
## 5    0     0    0    0    0      0     0    0     0      0     0     0
## 6    0     1    0    0    3      0     0    0     0      0     0     0
##   SEDES SEFRB SELA SIACS2 SIPR SOMU SOSIN STELL STLO2 TEACC TEGR3 TOPY
## 1     0     0    0      0    0    0     0     0     0     0     0    0
## 2     0     0    0      0   19    0     0     0     0     0     0    0
## 3     0     0    0      0    0    0     0     0     0     0     0    0
## 4     0     0    0      0    0    0     0     0     0     0     0    0
## 5     0     0    0      0   29    0     0     0     0     0     0    0
## 6     0     0    0      0    9    0     0     0     0     0     0    0
##   TRDA2 TRNA2 TRPAP TRSP2
## 1     0     0     0     0
## 2     0     0     9     0
## 3     0     0     0     0
## 4     0     0     4     0
## 5     0     0     4     0
## 6     0     0    21     0
```

```
nwt.1989 <- nwt.1989[,-which(colSums(nwt.1989) == 0)]
nwt.1989[,which(colSums(nwt.1989) == 0)]
```

```
## data frame with 0 columns and 88 rows
```

```
ems.1989 <- Metacommunity(
  decostand(nwt.1989[,-c(1:2)], method = "pa"),
  method = "r1", sims = 100)
IdentifyStructure(ems.1989)
```

```
## [1] "Checkerboard (negative coherence)"
```

Now, we'll take advantage of the time series data

```
# This function accepts wide-format dataset and prints EMS output
fn.ems.loop <- function(comm.wide){

  for(year.i in unique(comm.wide$year)){
    comm.year <- filter(comm.wide, year == year.i)[,-c(1:2)] # remove plot & year cols
    comm.year.pa <- decostand(comm.year, method = "pa")
    comm.year.pa <- comm.year.pa[,which(colSums(comm.year.pa) > 0)] # remove empty cols and rows
    comm.year.pa <- comm.year.pa[which(rowSums(comm.year.pa) > 0),]
    ems.year <- Metacommunity(
      comm.year.pa,
      method = "r1", sims = 100)
```

```
    #print(ems.year) # print raw values from EMS analysis
    print(IdentifyStructure(ems.year))  # prints the structure of the MC
  }

}
```

Now, call the function:

```
fn.ems.loop(nwt.comm.wide)
```

```
## [1] "Checkerboard (negative coherence)"
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## [1] "Checkerboard (negative coherence)"
```

References

Daniel Borcard, Pierre Legendre, and Pierre Drapeau. Partialling out the spatial component of ecological variation. *Ecology*, 73(3):1045–1055, 1992. ISSN 00129658. doi: 10.2307/1940179. URL http://www.jstor.org/stable/1940179.

Lou Jost. Partitioning diversity into independent alpha and beta components. *Ecology*, 88(10):2427–2439, 2007. ISSN 0012-9658. doi: 10.1890/06-1736.1. URL http://doi.wiley.com/10.1890/06-1736.1.

Pierre Legendre, Daniel Borcard, and Pedro R. Peres-Neto. Analyzing beta diversity: partitioning the spatial variation of community composition data. *Ecological Monographs*, 75(4):435–450, 2005.

Mathew A. Leibold and Gregory M Mikkelson. Coherence, species turnover, and boundary clumping: elements of meta-community structure. *Oikos*, 97:237–250, 2002. ISSN 1600-0706. doi: 10.1034/j.1600-0706.2002.970210.x.

Steven J. Presley, Christopher L. Higgins, and Michael R. Willig. A comprehensive framework for the evaluation of metacommunity structure. *Oikos*, 119(6):908–917, 2010. ISSN 00301299. doi: 10.1111/j.1600-0706.2010.18544.x.