Week 2 Exercise

Z620: Quantitative Biodiversity, Indiana University

November 8, 2014

In this exercise, we will conduct exercises on alpha diversity

RETRIEVE AND SET YOUR WORKING DIRECTORY

```
getwd()
```

```
## [1] "/Users/lennonj/GitHub/Quantitative_Biodiversity/Assignments/Week2"
```

```
setwd("/Users/lennonj/GitHub/Quantitative_Biodiversity/Assignments/Week2")
```

INSTALL PACKAGES

People develop different packages for certain tasks that can be carried out in the R enviornment. Use the 'help'funciton to learn about package installation and add-ons. install.packages("vegan")

```
require("vegan")
```

```
## Loading required package: vegan
## Loading required package: permute
## Loading required package: lattice
## This is vegan 2.0-10
```

```
library("vegan")
```

In the library of vegan, there is a data set that we will be using called BCI. BCI stands for Barro Colorado Island, which is a located in Panama. The BCI data frame has 50 plots (rows) of 1 hectare with counts of trees on each plot with total of 225 species (columns)

```
data(BCI)
```

Let's look at the data in the first few plots

```
head(BCI)
```

```
##   Abarema.macradenium Acacia.melanoceras Acalypha.diversifolia
## 1                   0                  0                     0
## 2                   0                  0                     0
## 3                   0                  0                     0
## 4                   0                  0                     0
## 5                   0                  0                     0
## 6                   0                  0                     0
##   Acalypha.macrostachya Adelia.triloba Aegiphila.panamensis
```

```
## 1                     0             0                   0
## 2                     0             0                   0
## 3                     0             0                   0
## 4                     0             3                   0
## 5                     0             1                   1
## 6                     0             0                   0
##   Alchornea.costaricensis Alchornea.latifolia Alibertia.edulis
## 1                       2                   0               0
## 2                       1                   0               0
## 3                       2                   0               0
## 4                      18                   0               0
## 5                       3                   0               0
## 6                       2                   1               0
##   Allophylus.psilospermus Alseis.blackiana Amaioua.corymbosa
## 1                       0              25                 0
## 2                       0              26                 0
## 3                       0              18                 0
## 4                       0              23                 0
## 5                       1              16                 0
## 6                       0              14                 0
##   Anacardium.excelsum Andira.inermis Annona.spraguei Apeiba.aspera
## 1                   0             0               1            13
## 2                   0             0               0            12
## 3                   0             0               1             6
## 4                   0             0               0             3
## 5                   0             1               0             4
## 6                   0             1               0            10
##   Apeiba.tibourbou Aspidosperma.cruenta Astrocaryum.standleyanum
## 1                2                    0                       0
## 2                0                    0                       2
## 3                1                    0                       1
## 4                1                    1                       5
## 5                0                    1                       6
## 6                0                    1                       2
##   Astronium.graveolens Attalea.butyracea Banara.guianensis
## 1                    6                 0                0
## 2                    0                 1                0
## 3                    1                 0                0
## 4                    3                 0                0
## 5                    0                 0                0
## 6                    1                 1                0
##   Beilschmiedia.pendula Brosimum.alicastrum Brosimum.guianense
## 1                     4                   5                 0
## 2                     5                   2                 0
## 3                     7                   4                 0
## 4                     5                   3                 0
## 5                     8                   2                 0
## 6                     6                   2                 0
##   Calophyllum.longifolium Casearia.aculeata Casearia.arborea
## 1                       0                 0               1
## 2                       2                 0               1
## 3                       0                 0               3
## 4                       2                 0               2
## 5                       1                 0               4
```

```
## 6                       2                 0                 1
##   Casearia.commersoniana Casearia.guianensis Casearia.sylvestris
## 1                      0                   0                   2
## 2                      0                   0                   1
## 3                      1                   0                   0
## 4                      0                   0                   0
## 5                      1                   0                   0
## 6                      0                   0                   3
##   Cassipourea.elliptica Cavanillesia.platanifolia Cecropia.insignis
## 1                     2                         0                12
## 2                     0                         0                 5
## 3                     1                         0                 7
## 4                     1                         0                17
## 5                     3                         0                21
## 6                     4                         0                 4
##   Cecropia.obtusifolia Cedrela.odorata Ceiba.pentandra Celtis.schippii
## 1                    0               0               0               0
## 2                    0               0               1               0
## 3                    0               0               1               0
## 4                    0               0               0               2
## 5                    1               0               1               2
## 6                    0               0               0               0
##   Cespedezia.macrophylla Chamguava.schippii Chimarrhis.parviflora
## 1                      0                  0                     0
## 2                      0                  0                     0
## 3                      0                  0                     0
## 4                      0                  0                     0
## 5                      0                  0                     0
## 6                      0                  0                     0
##   Chlorophora.tinctoria Chrysochlamys.eclipes Chrysophyllum.argenteum
## 1                     0                     0                      4
## 2                     0                     0                      1
## 3                     0                     0                      2
## 4                     0                     0                      2
## 5                     0                     0                      6
## 6                     0                     0                      2
##   Chrysophyllum.cainito Coccoloba.coronata Coccoloba.manzanillensis
## 1                     0                  0                       0
## 2                     0                  0                       0
## 3                     0                  0                       0
## 4                     0                  1                       0
## 5                     0                  2                       0
## 6                     0                  0                       0
##   Colubrina.glandulosa Cordia.alliodora Cordia.bicolor Cordia.lasiocalyx
## 1                    0                2             12                8
## 2                    0                3             14                6
## 3                    0                3             35                6
## 4                    0                7             23               11
## 5                    0                1             13                7
## 6                    0                1              7                6
##   Coussarea.curvigemmia Croton.billbergianus Cupania.cinerea
## 1                     0                    2               0
## 2                     0                    2               0
## 3                     0                    0               0
```

```
## 4                    1                  11              0
## 5                    0                   6              0
## 6                    2                   0              0
##   Cupania.latifolia Cupania.rufescens Cupania.sylvatica
## 1                 0                 0                2
## 2                 0                 0                2
## 3                 0                 0                1
## 4                 1                 0                0
## 5                 0                 0                3
## 6                 0                 0                0
##   Dendropanax.arboreus Desmopsis.panamensis Diospyros.artanthifolia
## 1                    0                    0                       1
## 2                    3                    0                       1
## 3                    6                    4                       1
## 4                    0                    0                       1
## 5                    5                    0                       0
## 6                    2                    0                       0
##   Dipteryx.panamensis Drypetes.standleyi Elaeis.oleifera
## 1                   1                 2              0
## 2                   1                 1              0
## 3                   3                 2              0
## 4                   0                 0              0
## 5                   0                 0              0
## 6                   0                 0              0
##   Enterolobium.schomburgkii Erythrina.costaricensis
## 1                         0                       0
## 2                         0                       0
## 3                         0                       0
## 4                         0                       0
## 5                         0                       0
## 6                         0                       3
##   Erythroxylum.macrophyllum Eugenia.coloradensis Eugenia.galalonensis
## 1                         0                    0                    0
## 2                         1                    1                    0
## 3                         0                    0                    0
## 4                         0                    7                    0
## 5                         0                    2                    0
## 6                         0                    0                    0
##   Eugenia.nesiotica Eugenia.oerstedeana Faramea.occidentalis
## 1                 0                   3                  14
## 2                 0                   2                  36
## 3                 1                   5                  39
## 4                 0                   1                  39
## 5                 0                   5                  22
## 6                 0                   2                  16
##   Ficus.colubrinae Ficus.costaricana Ficus.insipida Ficus.maxima
## 1                0                 0              0           1
## 2                1                 0              0           0
## 3                0                 0              0           0
## 4                0                 0              0           0
## 5                0                 0              0           0
## 6                0                 0              0           0
##   Ficus.obtusifolia Ficus.popenoei Ficus.tonduzii Ficus.trigonata
## 1                 0              0              0               0
```

```
## 2                 0              0              0              0
## 3                 0              0              1              0
## 4                 0              0              2              0
## 5                 0              0              1              0
## 6                 0              0              0              0
##   Ficus.yoponensis Garcinia.intermedia Garcinia.madruno Genipa.americana
## 1                1                   0                4                0
## 2                0                   1                0                0
## 3                0                   1                0                1
## 4                0                   3                0                0
## 5                0                   2                1                0
## 6                1                   1                0                0
##   Guapira.standleyana Guarea.fuzzy Guarea.grandifolia Guarea.guidonia
## 1                   3            1                  0               2
## 2                   1            1                  0               6
## 3                   0            0                  0               2
## 4                   1            1                  0               5
## 5                   1            3                  0               3
## 6                   7            0                  0               4
##   Guatteria.dumetorum Guazuma.ulmifolia Guettarda.foliacea
## 1                   6                 0                 1
## 2                  16                 0                 5
## 3                   6                 0                 1
## 4                   3                 1                 2
## 5                   9                 0                 1
## 6                   7                 0                 0
##   Gustavia.superba Hampea.appendiculata Hasseltia.floribunda
## 1               10                    0                   5
## 2                5                    0                   9
## 3                0                    1                   4
## 4                1                    0                  11
## 5                3                    0                   9
## 6                1                    0                   2
##   Heisteria.acuminata Heisteria.concinna Hirtella.americana
## 1                   0                  4                 0
## 2                   0                  5                 0
## 3                   0                  4                 0
## 4                   0                  6                 0
## 5                   1                  4                 0
## 6                   1                  8                 0
##   Hirtella.triandra Hura.crepitans Hyeronima.alchorneoides Inga.acuminata
## 1                21              0                       0              0
## 2                14              0                       2              0
## 3                 5              0                       0              0
## 4                 4              0                       0              0
## 5                 6              0                       0              0
## 6                 6              2                       0              0
##   Inga.cocleensis Inga.goldmanii Inga.laurina Inga.marginata Inga.nobilis
## 1               2              0            0              0            0
## 2               4              0            0              0            0
## 3               4              1            0              2            1
## 4               6              0            0              4            3
## 5               0              2            1              0            1
## 6               0              1            0              0            0
```

```
##   Inga.oerstediana Inga.pezizifera Inga.punctata Inga.ruiziana
## 1                0                0             3             0
## 2                0                0             0             0
## 3                0                0             0             0
## 4                0                0             0             0
## 5                0                0             0             0
## 6                0                0             0             0
##   Inga.sapindoides Inga.spectabilis Inga.umbellifera Jacaranda.copaia
## 1                2                0                0               6
## 2                0                2                0              10
## 3                3                0                0               9
## 4                2                1                1               2
## 5                5                0                0               3
## 6                0                0                0               7
##   Lacistema.aggregatum Lacmellea.panamensis Laetia.procera Laetia.thamnia
## 1                    1                    1              0              0
## 2                    0                    0              1              1
## 3                    0                    0              1              1
## 4                    1                    2              0              0
## 5                    1                    2              1              0
## 6                    2                    1              0              0
##   Lafoensia.punicifolia Licania.hypoleuca Licania.platypus
## 1                     0                 0                0
## 2                     0                 0                0
## 3                     0                 0                0
## 4                     0                 0                0
## 5                     0                 1                0
## 6                     0                 0                0
##   Lindackeria.laurina Lonchocarpus.latifolius Luehea.seemannii
## 1                   0                       7               1
## 2                   0                       7               0
## 3                   0                       3               0
## 4                   0                       9               0
## 5                   0                       2               1
## 6                   0                       1               1
##   Macrocnemum.roseum Maquira.costaricana Margaritaria.nobilis
## 1                  0                   4                    0
## 2                  0                   3                    0
## 3                  0                   7                    0
## 4                  0                   7                    0
## 5                  0                  10                    1
## 6                  0                   4                    0
##   Marila.laxiflora Maytenus.schippii Miconia.affinis Miconia.argentea
## 1                1                 2               0               2
## 2                0                 0               0               0
## 3                0                 0               0               1
## 4                0                 1               1               0
## 5                0                 0               0               1
## 6                0                 1               0               0
##   Miconia.elata Miconia.hondurensis Mosannona.garwoodii Myrcia.gatunensis
## 1             0                   0                   1                1
## 2             0                   0                   0                0
## 3             0                   0                   0                0
## 4             0                   0                   0                0
```

```
## 5             0                   0                   1                 0
## 6             0                   0                   1                 0
##   Myrospermum.frutescens Nectandra.cissiflora Nectandra.lineata
## 1                      0                   0                 0
## 2                      0                   1                 0
## 3                      0                   2                 0
## 4                      0                   2                 0
## 5                      0                   2                 0
## 6                      2                   0                 0
##   Nectandra.purpurea Ochroma.pyramidale Ocotea.cernua Ocotea.oblonga
## 1                  1                  1             0              0
## 2                  0                  0             0              0
## 3                  0                  0             1              1
## 4                  0                  0             1              2
## 5                  0                  0             0              0
## 6                  1                  0             0              0
##   Ocotea.puberula Ocotea.whitei Oenocarpus.mapora Ormosia.amazonica
## 1               0             1                22                 0
## 2               0             0                21                 0
## 3               0             2                14                 0
## 4               2             3                23                 0
## 5               0            16                17                 0
## 6               1             3                19                 0
##   Ormosia.coccinea Ormosia.macrocalyx Pachira.quinata Pachira.sessilis
## 1                0                  0               0                0
## 2                0                  0               0                0
## 3                0                  0               0                0
## 4                0                  0               0                0
## 5                0                  0               0                0
## 6                0                  0               0                0
##   Perebea.xanthochyma Phoebe.cinnamomifolia Picramnia.latifolia
## 1                   0                     0                  0
## 2                   1                     0                  0
## 3                   0                     1                  1
## 4                   0                     0                  0
## 5                   1                     1                  0
## 6                   0                     0                  0
##   Piper.reticulatum Platymiscium.pinnatum Platypodium.elegans
## 1                 0                     3                   2
## 2                 0                     3                   1
## 3                 0                     5                   3
## 4                 0                     1                   0
## 5                 2                     1                   0
## 6                 0                     1                   2
##   Posoqueria.latifolia Poulsenia.armata Pourouma.bicolor
## 1                    0              24                5
## 2                    1              16                3
## 3                    0              28                0
## 4                    0              15                0
## 5                    0              25                1
## 6                    0              15                0
##   Pouteria.fossicola Pouteria.reticulata Pouteria.stipitata
## 1                  0                   5                 0
## 2                  0                   7                 0
```

```
## 3                  0                  3                  1
## 4                  0                  6                  0
## 5                  0                  5                  0
## 6                  0                  4                  0
##   Prioria.copaifera Protium.costaricense Protium.panamense
## 1                13                   5                 2
## 2                12                   4                 0
## 3                12                   1                 2
## 4                 5                   3                 3
## 5                 3                   7                 2
## 6                26                   1                 1
##   Protium.tenuifolium Pseudobombax.septenatum Psidium.friedrichsthalianum
## 1                  11                       0                           0
## 2                   8                       0                           0
## 3                   3                       0                           0
## 4                   9                       0                           0
## 5                   3                       0                           0
## 6                   2                       0                           0
##   Psychotria.grandis Pterocarpus.rohrii Quararibea.asterolepis
## 1                  0                 1                     11
## 2                  0                 0                     12
## 3                  0                 0                     15
## 4                  0                 2                     14
## 5                  0                 1                      9
## 6                  0                 1                      3
##   Quassia.amara Randia.armata Sapium.broadleaf Sapium.glandulosum
## 1             0             3                0                 0
## 2             0             2                0                 0
## 3             0             1                0                 1
## 4             0             4                0                 0
## 5             0             2                0                 2
## 6             0             9                0                 0
##   Schizolobium.parahyba Senna.dariensis Simarouba.amara
## 1                     0               0              14
## 2                     0               0               6
## 3                     0               0              16
## 4                     0               0               8
## 5                     0               0               7
## 6                     1               0               7
##   Siparuna.guianensis Siparuna.pauciflora Sloanea.terniflora
## 1                   3                    0                 1
## 2                   2                    0                 0
## 3                   1                    1                 2
## 4                   2                    0                 2
## 5                   0                    3                 3
## 6                   1                    0                 2
##   Socratea.exorrhiza Solanum.hayesii Sorocea.affinis Spachea.membranacea
## 1                 15              0               1                   0
## 2                 22              0               1                   0
## 3                 31              0               1                   0
## 4                  9              0               1                   0
## 5                 55              1               0                   0
## 6                 44              0               1                   0
##   Spondias.mombin Spondias.radlkoferi Sterculia.apetala
```

```
## 1               1                   2                1
## 2               1                   0                2
## 3               0                   3                0
## 4               1                   3                0
## 5               1                   5                0
## 6               0                   0                1
##   Swartzia.simplex.var.grandiflora Swartzia.simplex.var.ochnacea
## 1                                3                             1
## 2                                3                             4
## 3                                0                             2
## 4                                1                             2
## 5                                1                             1
## 6                                9                             5
##   Symphonia.globulifera Tabebuia.guayacan Tabebuia.rosea
## 1                     0                 1              1
## 2                     1                 0              2
## 3                     1                 1              1
## 4                     1                 0              2
## 5                     2                 0              3
## 6                     0                 1              0
##   Tabernaemontana.arborea Tachigali.versicolor Talisia.nervosa
## 1                       9                    6              0
## 2                       5                    1              0
## 3                       6                    3              0
## 4                      10                    3              0
## 5                      16                    0              0
## 6                      11                    1              0
##   Talisia.princeps Terminalia.amazonia Terminalia.oblonga
## 1                1                   1                  0
## 2                0                   0                  0
## 3                0                   0                  0
## 4                0                   0                  0
## 5                0                   1                  0
## 6                0                   1                  0
##   Tetragastris.panamensis Tetrathylacium.johansenii Theobroma.cacao
## 1                       5                         0              1
## 2                       7                         0              1
## 3                      10                         0              0
## 4                      10                         0              0
## 5                       7                         0              1
## 6                      17                         0              0
##   Thevetia.ahouai Tocoyena.pittieri Trattinnickia.aspera Trema.micrantha
## 1               0                 0                    3              0
## 2               0                 1                    1              0
## 3               0                 0                    1              0
## 4               0                 0                    0              2
## 5               0                 0                    2              1
## 6               0                 0                    0              0
##   Trichanthera.gigantea Trichilia.pallida Trichilia.tuberculata
## 1                     0                 0                    18
## 2                     0                 1                    27
## 3                     0                 0                    28
## 4                     0                 1                    35
## 5                     0                 0                    15
```

```
## 6                     0                 0                    31
##   Trichospermum.galeottii Triplaris.cumingiana Trophis.caucana
## 1                       0                    0               2
## 2                       0                    0               0
## 3                       0                    0               0
## 4                       0                    0               0
## 5                       0                    0               2
## 6                       0                    1               0
##   Trophis.racemosa Turpinia.occidentalis Unonopsis.pittieri
## 1                1                     0                  1
## 2                1                     1                  5
## 3                0                     1                 12
## 4                1                     4                  3
## 5                0                     2                  4
## 6                0                     1                  3
##   Virola.multiflora Virola.sebifera Virola.surinamensis Vismia.baccifera
## 1                 0              17                   4                0
## 2                 0              12                   3                0
## 3                 0              11                   2                0
## 4                 0              16                   2                0
## 5                 0              31                   6                0
## 6                 2              19                   1                0
##   Vochysia.ferruginea Xylopia.macrantha Zanthoxylum.ekmanii
## 1                   0                 1                  3
## 2                   0                 0                  4
## 3                   0                 0                  8
## 4                   0                 0                 13
## 5                   0                 0                  3
## 6                   0                 0                  1
##   Zanthoxylum.juniperinum Zanthoxylum.panamense Zanthoxylum.setulosum
## 1                       0                    2                     0
## 2                       0                    2                     0
## 3                       1                    2                     0
## 4                       1                    5                     0
## 5                       0                    5                     0
## 6                       0                    3                     0
##   Zuelania.guidonia
## 1                 0
## 2                 0
## 3                 0
## 4                 1
## 5                 0
## 6                 2
```

Calculate Shannon index. 'Margin = 1' means diversity is calculated row-wise; 'Margin = 2' means diversity is calcualted column-wise.With base = exp(1), we are esimating Shannon's index using the natural logrithm of each taxon's relative abundance using the equation; H' = -Si pi ln (Pi)

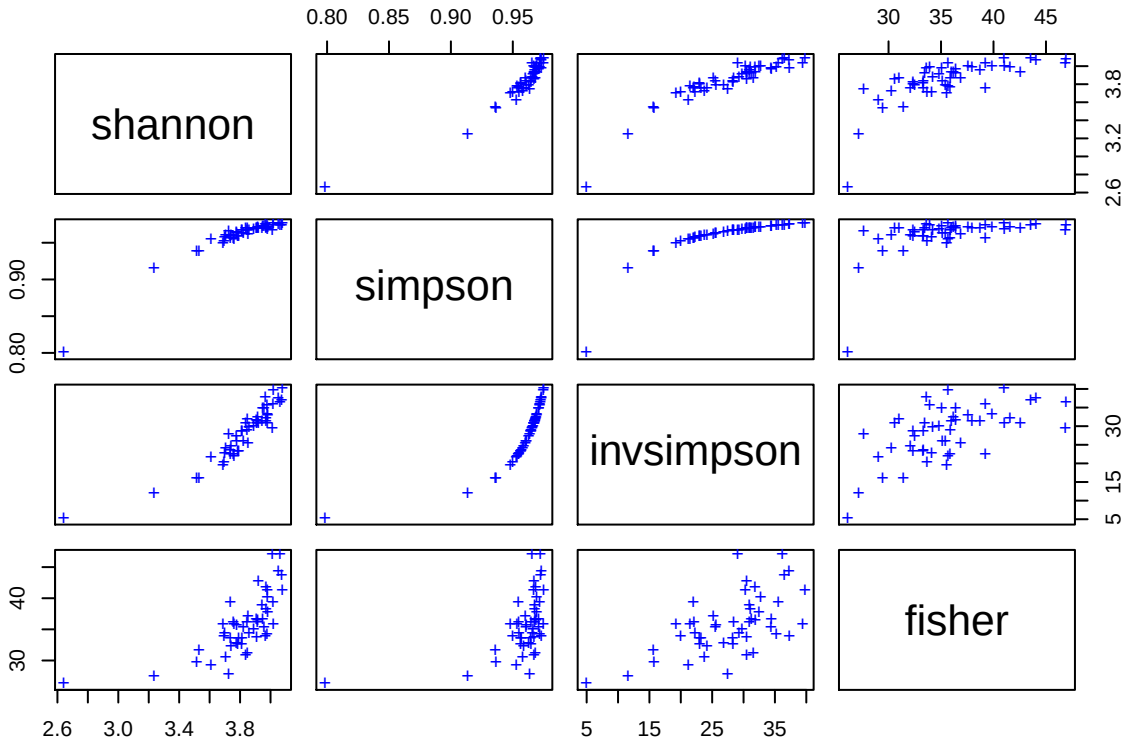
```
shannon<-diversity(BCI,index="shannon", MARGIN=1,base=exp(1))
```

Can also calculate other diversity metrics

```
simpson <- diversity(BCI, "simpson")
invsimpson <- diversity(BCI, "inv")
fisher <- fisher.alpha(BCI)
```

Let's plot

```
pairs(cbind(shannon, simpson, invsimpson, fisher), pch="+", col="blue")
```



Species richness

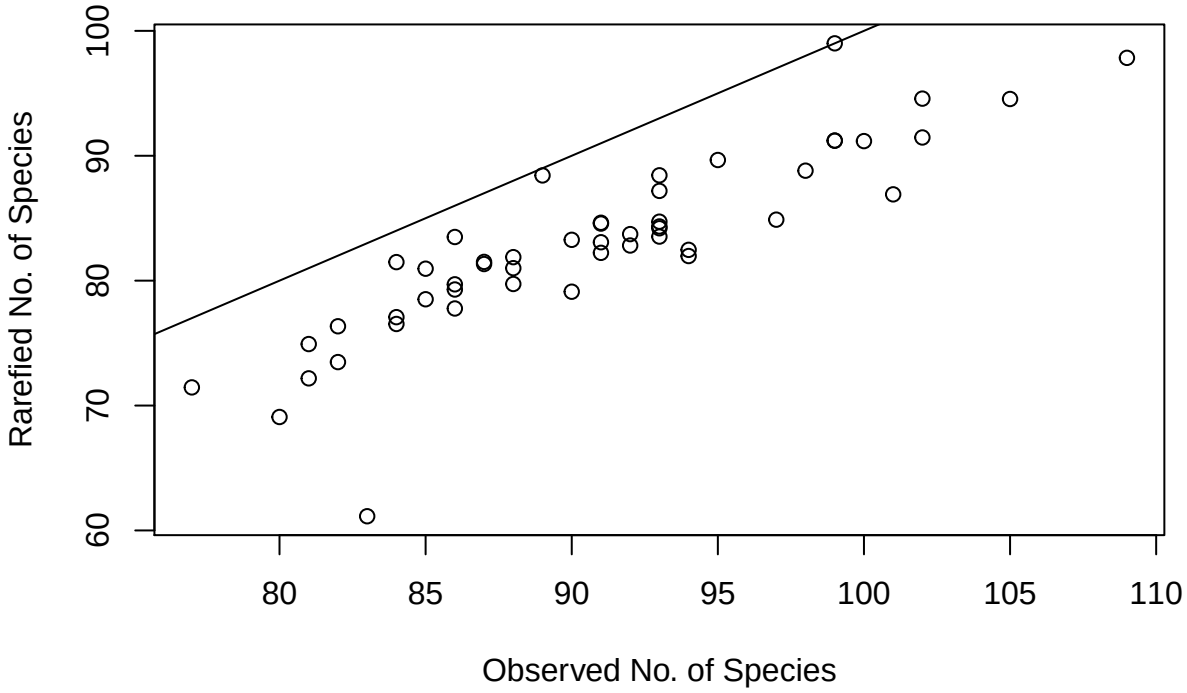
```
S <- specnumber(BCI)
```

Rarefaction

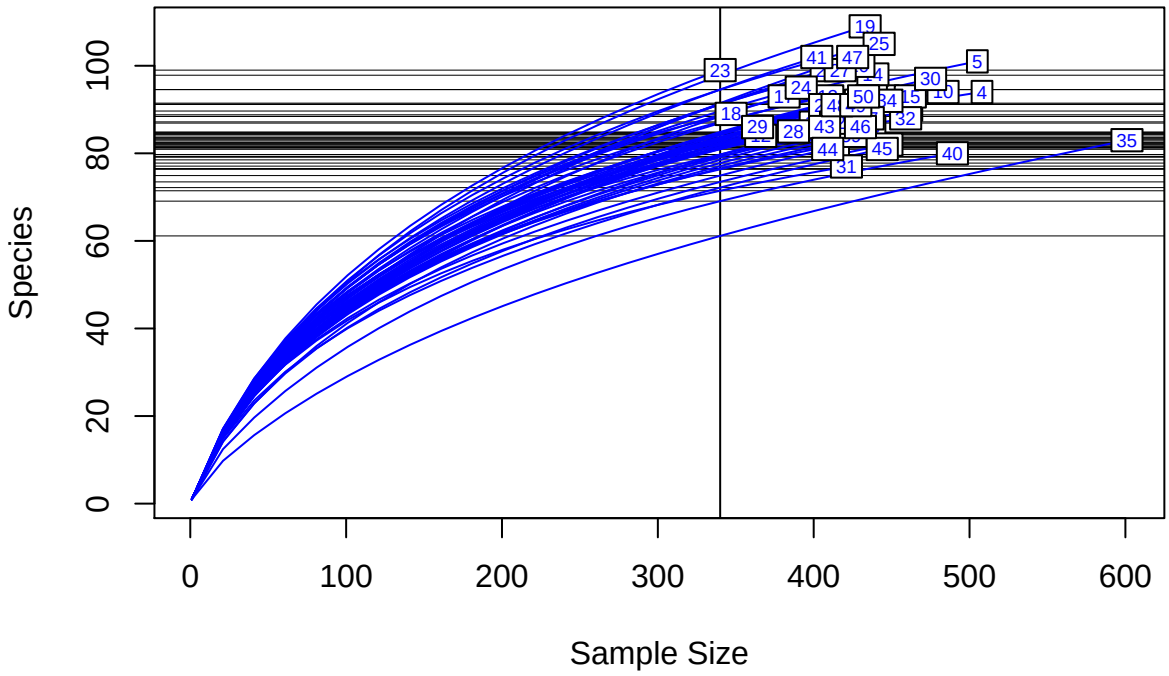
```
(raremax <- min(rowSums(BCI)))
```

```
## [1] 340
```

```
Srare <- rarefy(BCI, raremax)
plot(S, Srare, xlab = "Observed No. of Species", ylab = "Rarefied No. of Species")
abline(0, 1)
```




```
rarecurve(BCI, step = 20, sample = raremax, col = "blue", cex = 0.6)
```



Example: http://www.jennajacobs.org/R/rarefaction.html

Calculating relative abundances

```
BCI_t <- t(BCI)

BCIrel <- BCI_t
for(i in 1:ncol(BCI_t)){BCIrel[,i]=BCI_t[,i]/sum(BCI_t[,i])}
```

What's one way to test that this worked?

```
colSums(BCIrel)
```

```
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
##  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
## 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
##  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
```

Now let's create a rank abundance curve. First, let's rank taxa within a sample (site 1) by relative abundance

```
rad <- BCIrel[order(BCIrel[,1],decreasing=TRUE),]
head(rad)
```

```
##                              1       2       3        4       5       6
## Alseis.blackiana       0.05580 0.05977 0.03888 0.045276 0.03168 0.03398
```

```
## Poulsenia.armata      0.05357 0.03678 0.06048 0.029528 0.04950 0.03641
## Oenocarpus.mapora     0.04911 0.04828 0.03024 0.045276 0.03366 0.04612
## Hirtella.triandra     0.04688 0.03218 0.01080 0.007874 0.01188 0.01456
## Trichilia.tuberculata 0.04018 0.06207 0.06048 0.068898 0.02970 0.07524
## Virola.sebifera       0.03795 0.02759 0.02376 0.031496 0.06139 0.04612
##                            7       8       9      10      11      12
## Alseis.blackiana      0.04327 0.03248 0.03912 0.02899 0.03491 0.05191
## Poulsenia.armata      0.01923 0.03016 0.01222 0.04969 0.05486 0.02186
## Oenocarpus.mapora     0.04808 0.04640 0.04401 0.04141 0.04239 0.05191
## Hirtella.triandra     0.01683 0.03248 0.01956 0.01449 0.02993 0.01639
## Trichilia.tuberculata 0.06490 0.08353 0.15892 0.09524 0.10224 0.12568
## Virola.sebifera       0.01923 0.04408 0.03912 0.03520 0.01496 0.01639
##                           13      14       15       16       17      18
## Alseis.blackiana      0.01956 0.03881 0.032468 0.057208 0.081365 0.02017
## Poulsenia.armata      0.00000 0.02968 0.034632 0.073227 0.005249 0.00000
## Oenocarpus.mapora     0.04156 0.05023 0.023810 0.034325 0.081365 0.06916
## Hirtella.triandra     0.02689 0.02968 0.008658 0.009153 0.010499 0.03458
## Trichilia.tuberculata 0.08557 0.07534 0.071429 0.057208 0.094488 0.06628
## Virola.sebifera       0.00000 0.03881 0.034632 0.054920 0.013123 0.00000
##                           19      20      21      22       23      24
## Alseis.blackiana      0.030023 0.02331 0.02941 0.05263 0.014706 0.03571
## Poulsenia.armata      0.009238 0.03497 0.10784 0.01196 0.002941 0.01531
## Oenocarpus.mapora     0.055427 0.04429 0.02696 0.05742 0.064706 0.06122
## Hirtella.triandra     0.055427 0.02797 0.04167 0.01435 0.029412 0.03827
## Trichilia.tuberculata 0.101617 0.07692 0.05637 0.10048 0.067647 0.09694
## Virola.sebifera       0.027714 0.03497 0.03676 0.01675 0.026471 0.03061
##                           25      26      27       28       29       30
## Alseis.blackiana      0.04525 0.01720 0.04077 0.041344 0.041209 0.075789
## Poulsenia.armata      0.00905 0.05405 0.02158 0.002584 0.005495 0.016842
## Oenocarpus.mapora     0.03167 0.01474 0.02638 0.025840 0.043956 0.025263
## Hirtella.triandra     0.05882 0.05897 0.01918 0.023256 0.019231 0.006316
## Trichilia.tuberculata 0.05882 0.03686 0.04796 0.111111 0.129121 0.069474
## Virola.sebifera       0.02715 0.04914 0.02878 0.046512 0.024725 0.016842
##                           31       32       33       34       35      36
## Alseis.blackiana      0.02613 0.045752 0.055046 0.093960 0.154742 0.01860
## Poulsenia.armata      0.05701 0.004357 0.009174 0.002237 0.000000 0.03256
## Oenocarpus.mapora     0.01663 0.010893 0.022936 0.020134 0.006656 0.05581
## Hirtella.triandra     0.03325 0.017429 0.020642 0.008949 0.001664 0.05581
## Trichilia.tuberculata 0.07838 0.108932 0.084862 0.069351 0.049917 0.06512
## Virola.sebifera       0.04751 0.039216 0.036697 0.015660 0.018303 0.03256
##                           37       38       39      40      41      42
## Alseis.blackiana      0.04368 0.055928 0.089623 0.13292 0.03234 0.03140
## Poulsenia.armata      0.01379 0.002237 0.002358 0.00409 0.02736 0.06280
## Oenocarpus.mapora     0.03448 0.024609 0.009434 0.00409 0.02736 0.04589
## Hirtella.triandra     0.01609 0.006711 0.007075 0.01431 0.07711 0.04348
## Trichilia.tuberculata 0.07586 0.131991 0.186321 0.19836 0.04726 0.03623
## Virola.sebifera       0.03218 0.024609 0.016509 0.02249 0.02985 0.02899
##                           43      44      45      46       47      48
## Alseis.blackiana      0.01966 0.03178 0.02252 0.06744 0.040000 0.02892
## Poulsenia.armata      0.13514 0.13447 0.12838 0.00000 0.009412 0.05542
## Oenocarpus.mapora     0.02703 0.02445 0.01802 0.08372 0.065882 0.03614
## Hirtella.triandra     0.05651 0.04401 0.05856 0.05116 0.077647 0.09880
## Trichilia.tuberculata 0.08845 0.06357 0.05856 0.03721 0.037647 0.04578
## Virola.sebifera       0.03440 0.02445 0.02928 0.00000 0.025882 0.01687
```

```
##                             49      50
## Alseis.blackiana       0.014052 0.02083
## Poulsenia.armata       0.091335 0.09954
## Oenocarpus.mapora      0.009368 0.02778
## Hirtella.triandra      0.100703 0.06250
## Trichilia.tuberculata 0.060890 0.04167
## Virola.sebifera        0.014052 0.03241
```

Let's make a ranking now that species abundances are ordered/sorted

```
ranks <- seq(1,nrow(rad))
```

Let's create RAD plot

```
plot(ranks,rad[,1],type='l',col="black",xlab="Rank",lwd=8,ylab="Relative Abundance",xlim=range(ranks))
```