Homework 9 -

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Import Adiantum quantitative ecological data

```
adDat <- read.table("QuantitativeDataAdiantum1.csv",sep=",",header=T,stringsAsFactors = F)
head(adDat)
```

```
##   SitePatch SpeciesID Elevation PercentCanopyCover MicroSlope MicroAspect
## 1       1.1         P    231.00              85.44         30         110
## 2       1.2         P    224.59              88.82         31         102
## 3       2.1         P    384.00              88.82          5         211
## 4       2.2         P    379.00              87.26          7         179
## 5       3.1         P    594.00              85.70          3          70
## 6       4.1         P    575.00              87.52         24          76
##   MacroSlope MacroAspect AvgLitterDepth AvgDepthO AvgDepthA AvgDepthB
## 1       27.0         102           4.00    3.7500    13.000        NA
## 2       29.0         108           2.00    2.7500     7.000     10.16
## 3        7.5          90           2.80    3.2500    10.000        NA
## 4       10.0         292           1.25    2.5000     5.900      4.90
## 5       15.0          94           3.50    3.0000    13.660      7.00
## 6       22.0          70           2.50    1.3125     7.875      9.30
##   AvgSoilDepth   pH  Ompct    P  K   Ca  Mg   Zn    B   Mn   Cu   Fe  Al
## 1      27.0000 4.80  3.965 2.40 36  154  25 1.55 0.20 10.3 0.20 24.9 343
## 2      27.3000 4.89  6.240 2.05 60  406  74 8.20 0.25 49.8 0.20 27.6 125
## 3       5.6250 6.10  8.606 1.10 34 2010  89 3.60 0.15 30.0 0.10  2.5  25
## 4       7.2000 6.06  4.966 1.05 34 1525  67 3.00 0.20 12.4 0.15  5.2  79
## 5      10.0000 5.47 11.518 1.10 24  458  40 2.25 0.10 21.2 0.40  7.2 549
## 6      11.3125 5.82  4.966 0.90 44  989 128 2.05 0.15 12.9 0.10  9.5  60
##   Na  S ExchAcid  ECEC CaBaseSat MgBaseSat KBaseSat Pb Ni Cd Cr
## 1  9 20     7.06  1.07      9.47      2.56     1.14 NA NA NA NA
## 2 87 17     6.39  2.80     22.09      6.71     1.67 NA NA NA NA
## 3 13  6     2.71 10.88     73.96      5.46     0.64 NA NA NA NA
## 4  9  9     2.28  8.27     72.25      5.29     0.83 NA NA NA NA
## 5 12 14     7.38  2.68     22.75      3.31     0.61 NA NA NA NA
## 6  6  4     2.96  6.12     54.44     11.74     1.24 NA NA NA NA
```

```
tail(adDat)
```

```
##    SitePatch SpeciesID Elevation PercentCanopyCover MicroSlope MicroAspect
## 24       9.2         A  364.8456              58.40         42         258
## 25       9.3         V  309.9800              85.18         15         298
## 26       9.4        3x  352.1600              71.14         42         275
## 27      10.1         V  392.5824              66.20          5           0
## 28      10.2       A&V  434.6448              85.44         33         250
## 29      10.3         P  391.6680              83.62         18         273
##    MacroSlope MacroAspect AvgLitterDepth AvgDepthO AvgDepthA AvgDepthB
## 24         45         270       1.916667  1.666700  2.333333  3.000000
## 25         14         309       1.785714  3.300000  3.250000  6.666667
## 26         36         285       1.950000  1.944444  2.100000        NA
```

```
## 27          6           0       1.750000  2.375000 10.875000  5.500000
## 28         25         257       2.625000  2.812500  2.857143  1.125000
## 29         20         270       2.100000  3.800000  4.400000 11.700000
##    AvgSoilDepth   pH  Ompct     P   K    Ca   Mg   Zn    B   Mn   Cu  Fe Al
## 24      4.50000 6.40 28.899  4.70  86  394 1501 0.75 0.35 11.2 0.05 2.5  2
## 25     11.71429 5.94 14.157  2.15  33  247 1234 1.80 0.10  8.8 0.05 2.8  7
## 26      3.30000 5.36 53.287 12.85 125  836  993 3.35 0.10 13.2 0.05 3.8  5
## 27     38.10000 7.04  7.150  1.75  52  358 1213 0.95 0.25  7.6 0.55 2.2 31
## 28      5.87500 6.63 19.799  3.40  53  661 1282 0.75 0.30  7.6 0.10 3.2  4
## 29     20.00000 6.69  8.515  3.55  61 1183  923 5.60 0.25 18.4 0.05 2.6  6
##    Na S ExchAcid  ECEC CaBaseSat MgBaseSat KBaseSat   Pb   Ni   Cd   Cr
## 24  8 7     5.94 14.70      9.54     60.60     1.07 0.90 3.00 0.10 0.10
## 25  8 5     4.30 11.60      7.77     64.66     0.53 0.75 6.85 0.10 0.05
## 26  9 9    14.32 12.78     15.43     30.54     1.18 3.50 2.80 0.10 0.10
## 27  8 4     0.00 12.03     14.88     84.01     1.11 0.05 0.95 0.05 0.05
## 28 11 7     3.32 14.12     18.95     61.24     0.78 0.30 3.00 0.05 0.10
## 29  8 7     0.77 13.76     40.70     52.92     1.08 0.05 5.95 0.25 0.10
```

```
# Clean up data set by changing NA values to 0 - justified for this data-set where the missing values a
# Transform NA values to 0
adDat[is.na(adDat)]<- 0
head(adDat)
```

```
##   SitePatch SpeciesID Elevation PercentCanopyCover MicroSlope MicroAspect
## 1       1.1         P    231.00              85.44         30         110
## 2       1.2         P    224.59              88.82         31         102
## 3       2.1         P    384.00              88.82          5         211
## 4       2.2         P    379.00              87.26          7         179
## 5       3.1         P    594.00              85.70          3          70
## 6       4.1         P    575.00              87.52         24          76
##   MacroSlope MacroAspect AvgLitterDepth AvgDepthO AvgDepthA AvgDepthB
## 1       27.0         102           4.00    3.7500    13.000      0.00
## 2       29.0         108           2.00    2.7500     7.000     10.16
## 3        7.5          90           2.80    3.2500    10.000      0.00
## 4       10.0         292           1.25    2.5000     5.900      4.90
## 5       15.0          94           3.50    3.0000    13.660      7.00
## 6       22.0          70           2.50    1.3125     7.875      9.30
##   AvgSoilDepth   pH  Ompct    P  K   Ca  Mg   Zn    B   Mn   Cu   Fe  Al
## 1      27.0000 4.80  3.965 2.40 36  154  25 1.55 0.20 10.3 0.20 24.9 343
## 2      27.3000 4.89  6.240 2.05 60  406  74 8.20 0.25 49.8 0.20 27.6 125
## 3       5.6250 6.10  8.606 1.10 34 2010  89 3.60 0.15 30.0 0.10  2.5  25
## 4       7.2000 6.06  4.966 1.05 34 1525  67 3.00 0.20 12.4 0.15  5.2  79
## 5      10.0000 5.47 11.518 1.10 24  458  40 2.25 0.10 21.2 0.40  7.2 549
## 6      11.3125 5.82  4.966 0.90 44  989 128 2.05 0.15 12.9 0.10  9.5  60
##   Na  S ExchAcid  ECEC CaBaseSat MgBaseSat KBaseSat Pb Ni Cd Cr
## 1  9 20     7.06  1.07      9.47      2.56     1.14  0  0  0  0
## 2 87 17     6.39  2.80     22.09      6.71     1.67  0  0  0  0
## 3 13  6     2.71 10.88     73.96      5.46     0.64  0  0  0  0
## 4  9  9     2.28  8.27     72.25      5.29     0.83  0  0  0  0
## 5 12 14     7.38  2.68     22.75      3.31     0.61  0  0  0  0
## 6  6  4     2.96  6.12     54.44     11.74     1.24  0  0  0  0
```

```
dim(adDat)
```

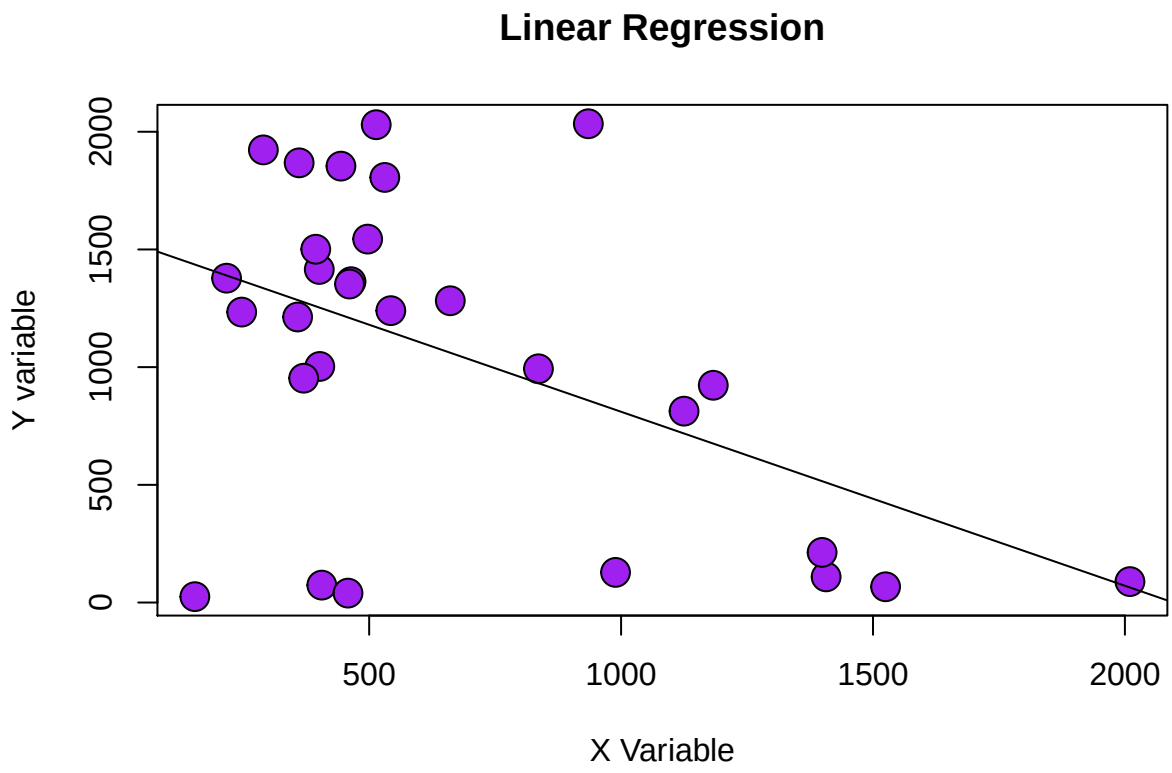
```
## [1] 29 36
```

Linear Regression of Ca:Mg ratio

```
# Use the linear regression function to test the relationship between soil concentrations of Ca and Mg,
linReg(xVar=adDat$Ca,yVar=adDat$Mg)
```

```
##        slope       pValue
## -0.739283171  0.006017112
```

```
# plot results using linRegPlot
linRegPlot(xVar=adDat$Ca,yVar=adDat$Mg)
```




```
## NULL
```

Logistic Regression of Depth A Soil Layer between A. aleuticum & A. viridi-montanum

‘‘‘

```
# subset out just the serpentine maidenhair data from adDat
serpDatA <- subset(adDat,SpeciesID=="A")
serpDatV <- subset(adDat,SpeciesID=="V")

# create new species id column so that to get rid of categorical letter id variable so that A. aleuticu
dim(serpDatA)
```

```
## [1]  6 36
```

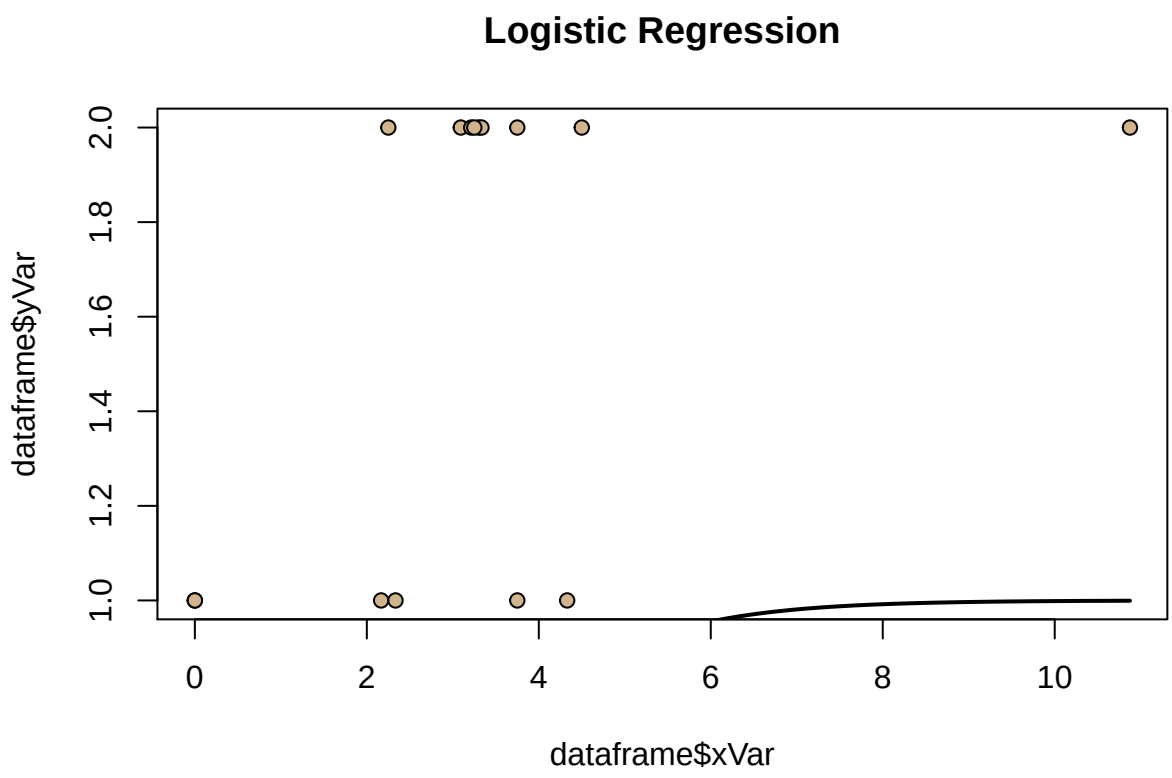
```
dim(serpDatV)
```

```
## [1]  9 36
```

```
id <- rep("0",length=6)
serpDatA <- cbind(serpDatA,id)

id <- rep("1",length=9)
serpDatV <- cbind(serpDatV,id)

# combine both subsets into a single data frame serpDat
serpDat <- rbind(serpDatA,serpDatV)

# Test the difference in depth of the A soil layer between the two serpentine maidenhairs using logisti
logReg(xVar=serpDat$AvgDepthA,yVar=serpDat$id)
```

```
##   xVarEst    pValue
## 0.8765369 0.1363388
```

```
logRegPlot(xVar=serpDat$AvgDepthA,yVar=serpDat$id)
```




```
## $x
##   [1]  0.00000  0.10875  0.21750  0.32625  0.43500  0.54375  0.65250
##   [8]  0.76125  0.87000  0.97875  1.08750  1.19625  1.30500  1.41375
##  [15]  1.52250  1.63125  1.74000  1.84875  1.95750  2.06625  2.17500
##  [22]  2.28375  2.39250  2.50125  2.61000  2.71875  2.82750  2.93625
```

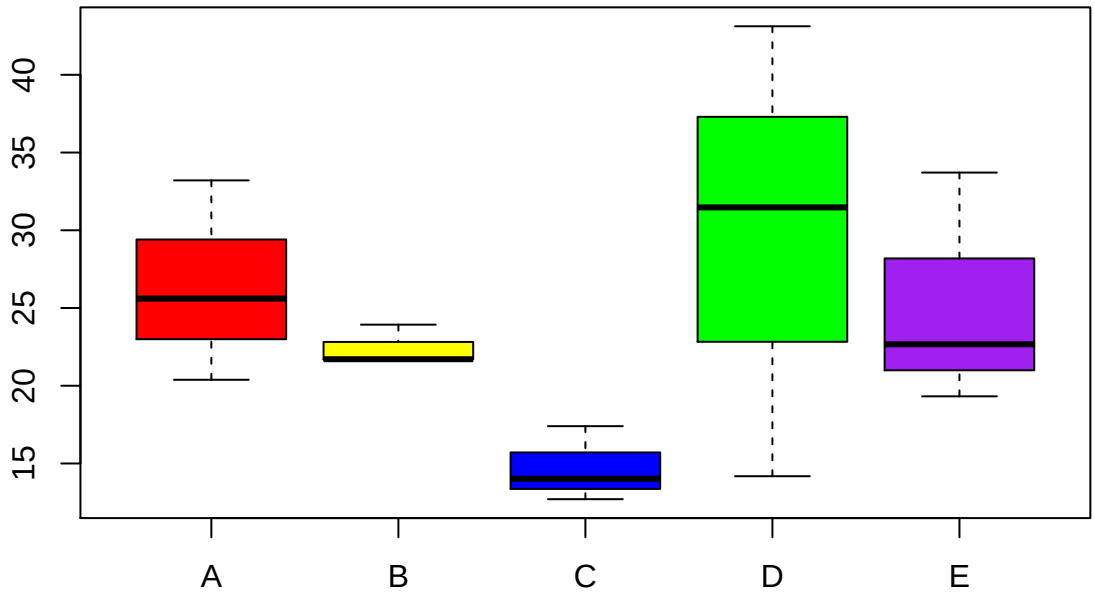
```
##  [29]  3.04500  3.15375  3.26250  3.37125  3.48000  3.58875  3.69750
##  [36]  3.80625  3.91500  4.02375  4.13250  4.24125  4.35000  4.45875
##  [43]  4.56750  4.67625  4.78500  4.89375  5.00250  5.11125  5.22000
##  [50]  5.32875  5.43750  5.54625  5.65500  5.76375  5.87250  5.98125
##  [57]  6.09000  6.19875  6.30750  6.41625  6.52500  6.63375  6.74250
##  [64]  6.85125  6.96000  7.06875  7.17750  7.28625  7.39500  7.50375
##  [71]  7.61250  7.72125  7.83000  7.93875  8.04750  8.15625  8.26500
##  [78]  8.37375  8.48250  8.59125  8.70000  8.80875  8.91750  9.02625
##  [85]  9.13500  9.24375  9.35250  9.46125  9.57000  9.67875  9.78750
##  [92]  9.89625 10.00500 10.11375 10.22250 10.33125 10.44000 10.54875
##  [99] 10.65750 10.76625 10.87500
##
## $y
##         1         2         3         4         5         6         7
## 0.1004828 0.1094327 0.1190743 0.1294420 0.1405682 0.1524834 0.1652143
##         8         9        10        11        12        13        14
## 0.1787839 0.1932101 0.2085048 0.2246731 0.2417123 0.2596110 0.2783486
##        15        16        17        18        19        20        21
## 0.2978944 0.3182076 0.3392366 0.3609197 0.3831850 0.4059514 0.4291293
##        22        23        24        25        26        27        28
## 0.4526223 0.4763283 0.5001415 0.5239540 0.5476580 0.5711479 0.5943215
##        29        30        31        32        33        34        35
## 0.6170824 0.6393413 0.6610170 0.6820379 0.7023422 0.7218787 0.7406065
##        36        37        38        39        40        41        42
## 0.7584951 0.7755239 0.7916819 0.8069662 0.8213822 0.8349417 0.8476628
##        43        44        45        46        47        48        49
## 0.8595684 0.8706855 0.8810443 0.8906775 0.8996195 0.9079057 0.9155720
##        50        51        52        53        54        55        56
## 0.9226546 0.9291890 0.9352100 0.9407518 0.9458470 0.9505271 0.9548220
##        57        58        59        60        61        62        63
## 0.9587602 0.9623687 0.9656727 0.9686961 0.9714610 0.9739883 0.9762973
##        64        65        66        67        68        69        70
## 0.9784058 0.9803306 0.9820869 0.9836890 0.9851500 0.9864819 0.9876959
##        71        72        73        74        75        76        77
## 0.9888021 0.9898098 0.9907277 0.9915637 0.9923248 0.9930178 0.9936486
##        78        79        80        81        82        83        84
## 0.9942227 0.9947452 0.9952207 0.9956534 0.9960470 0.9964051 0.9967309
##        85        86        87        88        89        90        91
## 0.9970273 0.9972968 0.9975420 0.9977650 0.9979678 0.9981522 0.9983199
##        92        93        94        95        96        97        98
## 0.9984724 0.9986111 0.9987373 0.9988519 0.9989562 0.9990510 0.9991372
##        99       100       101
## 0.9992156 0.9992869 0.9993517
```

Test variation in depth of the A layer between species groups using ANOVA

Run ANOV & ANOVplot functions from HW8

```
ANOV <- function(xVar=as.factor(rep(c("A","B","C","D","E"),each=3)),
                     yVar=c(rgamma(10,shape=5,scale=5),rgamma(5,shape=5,scale=10))){
                       df=data.frame(xVar,yVar)
          aovMod <- aov(yVar~xVar,data=df)
```

```
          aovOut <- summary(aovMod)[[1]][["Pr(>F)"]][1]
         return(aovOut)}

ANOVplot <- function(xVar=as.factor(rep(c("A","B","C","D","E"),each=3)),yVar=c(rgamma(15,shape=5,scale=5
  df <- data.frame(xVar,yVar)
  aovMod <- aov(yVar~xVar,data=df)
  aovPlot <-  boxplot(yVar~xVar,
                      data=df,
                      col=c("red","yellow","blue","green","purple"),
                     xlab=names(xVar),ylab=names(yVar))
  return(aovPlot)}

ANOVplot()
```



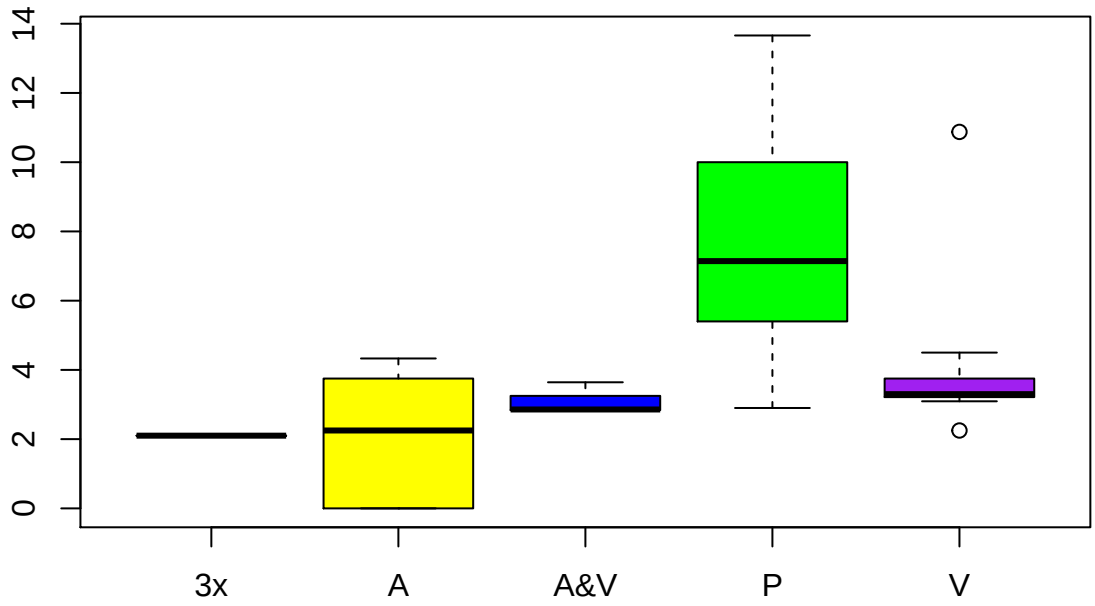

```
## $stats
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 20.38504 21.68080 12.70454 14.18129 19.31944
## [2,] 22.99550 21.69299 13.36213 22.82708 20.99314
## [3,] 25.60596 21.70519 14.01972 31.47286 22.66684
## [4,] 29.40754 22.81808 15.71014 37.29727 28.18973
## [5,] 33.20912 23.93096 17.40055 43.12167 33.71262
##
## $n
## [1] 3 3 3 3 3
##
## $conf
```

```
##          [,1]     [,2]     [,3]     [,4]     [,5]
## [1,] 19.75682 20.67887 11.87784 18.27296 16.10202
## [2,] 31.45511 22.73150 16.16161 44.67277 29.23167
##
## $out
## numeric(0)
##
## $group
## numeric(0)
##
## $names
## [1] "A" "B" "C" "D" "E"
```

```
ANOV(xVar=adDat$SpeciesID,yVar=adDat$AvgDepthA)
```

```
## [1] 0.00480182
```

```
ANOVplot(xVar=adDat$SpeciesID,yVar=adDat$AvgDepthA)
```




```
## $stats
##      [,1] [,2]     [,3]      [,4]     [,5]
## [1,]  2.1 0.00 2.818182  2.900000 3.093000
## [2,]  2.1 0.00 2.837662  5.400000 3.214286
## [3,]  2.1 2.25 2.857143  7.142857 3.300000
## [4,]  2.1 3.75 3.250000 10.000000 3.750000
## [5,]  2.1 4.33 3.642857 13.660000 4.500000
##
## $n
```

```
## [1]  1  6  3 10  9
##
## $conf
##      [,1]       [,2]     [,3]     [,4]     [,5]
## [1,]  2.1 -0.1688711 2.481003 4.844514 3.017857
## [2,]  2.1  4.6688711 3.233283 9.441201 3.582143
##
## $out
## [1]  2.250 10.875
##
## $group
## [1] 5 5
##
## $names
## [1] "3x"  "A"   "A&V" "P"   "V"
```

Construct random data set with the same structure as original data

```
library(MASS)
fitMg <- fitdistr(adDat$Mg,"gamma")
```

```
## Warning in densfun(x, parm[1], parm[2], ...): NaNs produced

## Warning in densfun(x, parm[1], parm[2], ...): NaNs produced

## Warning in densfun(x, parm[1], parm[2], ...): NaNs produced
```

```
ranMg <- rnorm(30,mean=1050,sd=670)

fitdistr(adDat$Ca,"normal")
```

```
##      mean         sd
##   675.24138   451.42622
##  ( 83.82774) ( 59.27517)
```

```
ranCa <- rnorm(30,mean=675,sd=451)

randomData <- cbind(ranCa,ranMg)
head(randomData)
```

```
##          ranCa     ranMg
## [1,]  495.7974  943.5656
## [2,]  464.0230 1841.1826
## [3,] 1260.5745 1602.3561
## [4,]  481.5407  809.7799
## [5,] 1174.9180  959.9166
## [6,] 1459.5267 1391.7099
```

Construct random data set with same structure as original data using dgamma

```
library(MASS)
# use the fitdistr function to get parameters of percent organic matter in soil using gamma distributio
fitom <- fitdistr(adDat$Ompct,"gamma")
```

```r
# make a new randomly generated %OM variable using parameters from above
randOM <- rgamma(30,fitom$estimate[1],fitom$estimate[2])

# Create vector of species id's and assign to randomly generated randOM values
spID <- c("A","V")
ranSpID <- rep(spID,length=30)
ranDat <- data.frame(ranSpID,randOM)

#Run ANOVA with randomly generated values - returns non-significant result
ANOV(xVar=ranDat$ranSpID,yVar=ranDat$randOM)
```

```
## [1] 0.2364415
```