Grade_analysis

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```
rm(list=ls())
#setwd('~/19. UBC 2016 Winter Term 2/STAT 550/Case/Code')
setwd('D:/github_folder/Stat550/Rscript')


library(ggplot2) # for plotting
library(lme4) # for mixed-effects models
library(reshape2) # for ...
library(dplyr) # for %>% & group_by
library(MASS) # for ...
library(base) # for ...

# Import the MWD data.
soil <- read.table('MWD.csv', sep=',', header=T)
soil.unreleveled <- soil
soil$Treatment <- relevel(soil$Treatment, ref='con')
head(soil)
```

```
##   Sample  Date Block Treatment Transect  MWD
## 1      1 April    b1       bio        1 1.05
## 2      2 April    b1       bio        2 0.95
## 3      3 April    b1       bio        3 0.99
## 4      4 April    b3       bio        1 0.82
## 5      5 April    b3       bio        2 0.84
## 6      6 April    b3       bio        3 0.96
```

```
str(soil)
```

```
## 'data.frame':    96 obs. of  6 variables:
##  $ Sample   : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Date     : Factor w/ 4 levels "April","Aug",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Block    : Factor w/ 4 levels "b1","b2","b3",..: 1 1 1 3 3 3 2 2 2 4 ...
##  $ Treatment: Factor w/ 2 levels "con","bio": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Transect : int  1 2 3 1 2 3 1 2 3 1 ...
##  $ MWD      : num  1.05 0.95 0.99 0.82 0.84 0.96 1.11 1.25 1.11 1.23 ...
```

```
with(soil, table(Treatment,Date))
```

```
##          Date
## Treatment April Aug June Oct
##       con    12  12   12  12
##       bio    12  12   12  12
```

```
# Import the cover value data.
pc <- read.csv('plant_cover.csv', header=T)
pc$Block <- as.factor(pc$Block)
head(pc)
```

```
##                       Project          Date Block Treatment Transect Plot
## 1 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
```

```
## 2 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
## 3 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
## 4 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
## 5 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
## 6 OK Ranch Biosolids Resample June 21, 2016     1 Biosolids        1    2
##   Species Cover.class Cover.value
## 1    ACMI           1         2.5
## 2    ALCE           1         2.5
## 3    ASAG           1         2.5
## 4    BIOS           2        15.0
## 5    HECO           4        62.5
## 6    LITT           5        85.0
```

```
str(pc)
```

```
## 'data.frame':    2669 obs. of  9 variables:
##  $ Project    : Factor w/ 1 level "OK Ranch Biosolids Resample": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Date       : Factor w/ 2 levels "June 21, 2016",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Block      : Factor w/ 4 levels "1","2","3","4": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Treatment  : Factor w/ 2 levels "Biosolids","Control": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Transect   : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ Plot       : int  2 2 2 2 2 2 2 2 2 3 ...
##  $ Species    : Factor w/ 50 levels "ACMI","ACRI",..: 1 3 9 11 29 33 39 47 48 3 ...
##  $ Cover.class: int  1 1 1 2 4 5 3 3 1 2 ...
##  $ Cover.value: num  2.5 2.5 2.5 15 62.5 85 37.5 37.5 2.5 15 ...
```

```
with(pc, table(Treatment,Block))
```

```
##            Block
## Treatment     1   2   3   4
##   Biosolids 301 301 239 267
##   Control   420 406 353 382
```

```
tapply(pc$Cover.value, pc$Treatment, table)
```

```
## $Biosolids
##
##  2.5   15 37.5 62.5   85 97.5
##  405  265  111   78   91  158
##
## $Control
##
##  2.5   15 37.5 62.5   85 97.5
##  676  510  243   94   35    3
```

```
################################
# Grad Analysis:
################################

# Obtain the relevant species.
# Note: The client said they are interested in POPR, PSSP, POJU, HECO,
#       ALCE, ANDI, TAOF, SOIL and BRYO, as well as anything with a cover
#       greater than 5% across all the sites.
#     : None of the species occurred in all of the 400 sites (4 blocks x
#       2 treatments × 5 transects × 10 samples per transect), although HECO
#       and LITT were close. The rest occurred in below half of the sites.
#       So, we change our criterion to choose species whose averages over
```

```
#       the (occurring) transects and plots, for every block-treatment
#       combination, are all greater than 5%.
summary(pc$Species)
```

```
## ACMI ACRI ALCE ANDI ANMI ARCA ARFR ARHO ASAG ASMI BIOS BRTE BRYO CAFI CAMI
##   66    6  134   81  103    1   90   12  187   11   36    2  199    1    3
## CAOB CAPE CASP CEAR COUM DEPI ELTR ERCO FECE FEOC GAAR GABO GETR HECO JUBA
##    2    1    6    1    5   10    1   19   25    3    3    3    1  353   21
## KOMA LILE LITT LOMA ORLU OXSE PEPR POHI POJU POPR POSE PSSP ROAC SECA SIAL
##  183    9  398    2    1    3    3    1   62  120   84   48    5    1    3
## SOIL TAOF TRDU TRPR ZIVE
##  186  107   60    5    2
```

```
all.species <- levels(pc$Species)
interesting <- c('POPR', 'PSSP', 'POJU', 'HECO', 'ALCE', 'ANDI', 'TAOF',
                 'SOIL', 'BRYO')
with(pc, table(Species, Block))
```

```
##         Block
## Species   1   2   3   4
##    ACMI  17   6  15  28
##    ACRI   4   0   0   2
##    ALCE  83  46   4   1
##    ANDI  16  28  19  18
##    ANMI  27  37  28  11
##    ARCA   1   0   0   0
##    ARFR  12  27  18  33
##    ARHO   2   7   2   1
##    ASAG  50  30  51  56
##    ASMI  10   0   1   0
##    BIOS   6  17   2  11
##    BRTE   0   0   0   2
##    BRYO  50  52  47  50
##    CAFI   0   0   1   0
##    CAMI   0   0   0   3
##    CAOB   0   2   0   0
##    CAPE   1   0   0   0
##    CASP   0   0   5   1
##    CEAR   0   0   1   0
##    COUM   5   0   0   0
##    DEPI   0   0  10   0
##    ELTR   0   0   1   0
##    ERCO  16   0   0   3
##    FECE   0  23   0   2
##    FEOC   0   0   2   1
##    GAAR   2   0   0   1
##    GABO   2   0   1   0
##    GETR   0   0   1   0
##    HECO  89  95  91  78
##    JUBA   0   0   4  17
##    KOMA  37  61  37  48
##    LILE   9   0   0   0
##    LITT 100 100  99  99
##    LOMA   2   0   0   0
```

```
##    ORLU   1   0   0   0
##    OXSE   1   0   2   0
##    PEPR   3   0   0   0
##    POHI   0   0   0   1
##    POJU  12  41   4   5
##    POPR  34  14  30  42
##    POSE  15  28   7  34
##    PSSP  21  18   1   8
##    ROAC   0   0   0   5
##    SECA   0   0   0   1
##    SIAL   1   2   0   0
##    SOIL  50  65  34  37
##    TAOF  29   4  47  27
##    TRDU   9   2  26  23
##    TRPR   3   2   0   0
##    ZIVE   1   0   1   0
```

```
with(pc, table(Species, Treatment))
```

```
##        Treatment
## Species Biosolids Control
##    ACMI        39      27
##    ACRI         2       4
##    ALCE        55      79
##    ANDI         0      81
##    ANMI         5      98
##    ARCA         0       1
##    ARFR        24      66
##    ARHO         1      11
##    ASAG        60     127
##    ASMI         1      10
##    BIOS        36       0
##    BRTE         2       0
##    BRYO         6     193
##    CAFI         1       0
##    CAMI         3       0
##    CAOB         0       2
##    CAPE         0       1
##    CASP         4       2
##    CEAR         0       1
##    COUM         0       5
##    DEPI        10       0
##    ELTR         1       0
##    ERCO         0      19
##    FECE        10      15
##    FEOC         0       3
##    GAAR         0       3
##    GABO         3       0
##    GETR         1       0
##    HECO       160     193
##    JUBA        19       2
##    KOMA        38     145
##    LILE         0       9
##    LITT       199     199
##    LOMA         1       1
```

```
##    ORLU         0       1
##    OXSE         1       2
##    PEPR         0       3
##    POHI         1       0
##    POJU        53       9
##    POPR       115       5
##    POSE        13      71
##    PSSP        38      10
##    ROAC         5       0
##    SECA         0       1
##    SIAL         3       0
##    SOIL        51     135
##    TAOF       101       6
##    TRDU        43      17
##    TRPR         3       2
##    ZIVE         0       2
```

```
species.vec <- NULL
for (ii in 1:length(all.species))
{
  # Obtain the subset of the data corresponding to this species.
  species.try <- all.species[ii]
  pc.sub.try <- subset(pc, Species==species.try)
  pc.sub.try <- pc.sub.try[ ,c(3,4,5,6,9)]

  # Check if this species occurrs in every block-treatment combination.
  # Note: entries.try is the table of counts for each block, by treatment
  #       group, for this species.
  entries.try <- table(pc.sub.try$Block, pc.sub.try$Treatment)
  which.entries.miss.try <- which(entries.try==0, arr.ind=TRUE)
  is.in.all.combs <- ifelse(test=(nrow(which.entries.miss.try)==0), yes=1,
                            no=0)

  # Obtain averages over the (occurring) transects and plots, for every
  # (occurring) block-treatment combination.
  by_blockTrt.try <- group_by(pc.sub.try, Block, Treatment)
  #dat.avg.try <- summarise(by_blockTrt.try, y.avg=sum(Cover.value)/50)
  dat.avg.try2 <- summarise(by_blockTrt.try, y.avg=mean(Cover.value))
  print(species.try)
  print(dat.avg.try2)
  all.occurring.greater.than5 <- ifelse(test=(sum(dat.avg.try2$y.avg<5)==0),
                                        yes=1, no=0)
  all.greater.than5 <- is.in.all.combs * all.occurring.greater.than5

  # Determine whether the species should be included.
  if ((species.try%in%interesting) || (all.greater.than5))
  {
    species.vec <- c(species.vec, species.try)
  }
}
```

```
## [1] "ACMI"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
```

```
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids  5.441176
## 2      2 Biosolids  2.500000
## 3      2   Control  2.500000
## 4      3 Biosolids  8.750000
## 5      3   Control 10.961538
## 6      4 Biosolids  5.666667
## 7      4   Control  2.500000
## [1] "ACRI"
## Source: local data frame [3 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 26.25
## 2      1   Control 15.00
## 3      4   Control 20.00
## [1] "ALCE"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids 21.060606
## 2      1   Control 19.700000
## 3      2 Biosolids  6.875000
## 4      2   Control  4.903846
## 5      3 Biosolids  2.500000
## 6      3   Control  2.500000
## 7      4   Control  2.500000
## [1] "ANDI"
## Source: local data frame [4 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1   Control 2.500000
## 2      2   Control 6.071429
## 3      3   Control 3.157895
## 4      4   Control 3.194444
## [1] "ANMI"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids  2.50000
## 2      1   Control 15.00000
## 3      2 Biosolids 22.50000
## 4      2   Control 13.38235
## 5      3   Control 12.41071
## 6      4 Biosolids 15.00000
## 7      4   Control  8.75000
```

```
## [1] "ARCA"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control    15
## [1] "ARFR"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids 14.375000
## 2      1   Control 10.000000
## 3      2 Biosolids  8.750000
## 4      2   Control  4.705882
## 5      3 Biosolids  2.500000
## 6      3   Control 11.029412
## 7      4 Biosolids 11.666667
## 8      4   Control 10.729167
## [1] "ARHO"
## Source: local data frame [5 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids   2.5
## 2      1   Control   2.5
## 3      2   Control   2.5
## 4      3   Control   2.5
## 5      4   Control   2.5
## [1] "ASAG"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids 11.300000
## 2      1   Control  6.500000
## 3      2 Biosolids  3.636364
## 4      2   Control  3.815789
## 5      3 Biosolids 11.250000
## 6      3   Control 10.000000
## 7      4 Biosolids  7.857143
## 8      4   Control  5.119048
## [1] "ASMI"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control  8.75
## 2      3 Biosolids  2.50
```

```
## [1] "BIOS"
## Source: local data frame [4 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 6.666667
## 2      2 Biosolids 6.176471
## 3      3 Biosolids 2.500000
## 4      4 Biosolids 7.045455
## [1] "BRTE"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      4 Biosolids  8.75
## [1] "BRYO"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1   Control 40.60000
## 2      2 Biosolids  8.75000
## 3      2   Control 24.73958
## 4      3   Control 33.13830
## 5      4 Biosolids 26.25000
## 6      4   Control 30.26042
## [1] "CAFI"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3 Biosolids   2.5
## [1] "CAMI"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      4 Biosolids   2.5
## [1] "CAOB"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      2   Control   2.5
## [1] "CAPE"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
```

```
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control    15
## [1] "CASP"
## Source: local data frame [3 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3 Biosolids  15.0
## 2      3   Control   2.5
## 3      4   Control   2.5
## [1] "CEAR"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3   Control  37.5
## [1] "COUM"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control     5
## [1] "DEPI"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3 Biosolids     5
## [1] "ELTR"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3 Biosolids    85
## [1] "ERCO"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment   y.avg
##   <fctr>    <fctr>   <dbl>
## 1      1   Control 3.28125
## 2      4   Control 2.50000
## [1] "FECE"
## Source: local data frame [4 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
```

```
## 1      2 Biosolids  6.388889
## 2      2   Control  6.964286
## 3      4 Biosolids  2.500000
## 4      4   Control 37.500000
## [1] "FEOC"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3   Control  8.75
## 2      4   Control  2.50
## [1] "GAAR"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control   2.5
## 2      4   Control   2.5
## [1] "GABO"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids  8.75
## 2      3 Biosolids 37.50
## [1] "GETR"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      3 Biosolids   2.5
## [1] "HECO"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 35.37500
## 2      1   Control 24.13265
## 3      2 Biosolids 31.08696
## 4      2   Control 29.48980
## 5      3 Biosolids 58.39286
## 6      3   Control 44.23469
## 7      4 Biosolids 42.34375
## 8      4   Control 30.05435
## [1] "JUBA"
## Source: local data frame [3 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
```

```
##   <fctr>    <fctr>     <dbl>
## 1      3 Biosolids 11.875000
## 2      4 Biosolids  8.166667
## 3      4   Control  2.500000
## [1] "KOMA"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids  8.500000
## 2      1   Control  7.129630
## 3      2 Biosolids 12.125000
## 4      2   Control  9.451220
## 5      3 Biosolids  6.666667
## 6      3   Control  8.308824
## 7      4 Biosolids  7.500000
## 8      4   Control 12.093023
## [1] "LILE"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control   2.5
## [1] "LITT"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 93.70000
## 2      1   Control 30.30000
## 3      2 Biosolids 82.85000
## 4      2   Control 28.35000
## 5      3 Biosolids 94.23469
## 6      3   Control 46.30000
## 7      4 Biosolids 86.15000
## 8      4   Control 33.36735
## [1] "LOMA"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids   2.5
## 2      1   Control   2.5
## [1] "ORLU"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control   2.5
```

```
## [1] "OXSE"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 85.00
## 2      3   Control  8.75
## [1] "PEPR"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1   Control 6.666667
## [1] "POHI"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      4 Biosolids    15
## [1] "POJU"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 14.54545
## 2      1   Control 15.00000
## 3      2 Biosolids 33.71622
## 4      2   Control  8.75000
## 5      3   Control  2.50000
## 6      4 Biosolids 12.50000
## [1] "POPR"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 37.82258
## 2      1   Control  2.50000
## 3      2 Biosolids 34.82143
## 4      3 Biosolids 46.29310
## 5      3   Control  2.50000
## 6      4 Biosolids 52.92683
## 7      4   Control 15.00000
## [1] "POSE"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1   Control  4.166667
```

```
## 2      2 Biosolids 14.545455
## 3      2   Control  9.705882
## 4      3   Control  6.071429
## 5      4 Biosolids  2.500000
## 6      4   Control  7.890625
## [1] "PSSP"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids 44.264706
## 2      1   Control 11.875000
## 3      2 Biosolids 21.666667
## 4      2   Control  2.500000
## 5      3 Biosolids 37.500000
## 6      4 Biosolids 19.500000
## 7      4   Control  6.666667
## [1] "ROAC"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      4 Biosolids   9.5
## [1] "SECA"
## Source: local data frame [1 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      4   Control    15
## [1] "SIAL"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids   2.5
## 2      2 Biosolids   2.5
## [1] "SOIL"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids  3.888889
## 2      1   Control  6.341463
## 3      2 Biosolids  4.880952
## 4      2   Control 11.022727
## 5      3 Biosolids  3.636364
## 6      3   Control  4.673913
## 7      4 Biosolids  2.500000
## 8      4   Control 12.314815
```

```
## [1] "TAOF"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment     y.avg
##   <fctr>    <fctr>     <dbl>
## 1      1 Biosolids  5.648148
## 2      1   Control  2.500000
## 3      2 Biosolids  2.500000
## 4      3 Biosolids 12.555556
## 5      3   Control  2.500000
## 6      4 Biosolids  6.400000
## 7      4   Control  2.500000
## [1] "TRDU"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 2.500000
## 2      2 Biosolids 2.500000
## 3      3 Biosolids 8.815789
## 4      3   Control 4.285714
## 5      4 Biosolids 5.384615
## 6      4   Control 2.500000
## [1] "TRPR"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment    y.avg
##   <fctr>    <fctr>    <dbl>
## 1      1 Biosolids 10.83333
## 2      2   Control  2.50000
## [1] "ZIVE"
## Source: local data frame [2 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control  15.0
## 2      3   Control   2.5
```

```
print(species.vec)
```

```
##  [1] "ALCE" "ANDI" "BRYO" "HECO" "KOMA" "LITT" "POJU" "POPR" "PSSP" "SOIL"
## [11] "TAOF"
```

```
# Obtain the MWD averages (to be used in calculating the correlations).
a <- group_by(soil.unreleveled, Block, Treatment) %>%
  summarise(mean(MWD))
b <- a$`mean(MWD)`
mean.MWD <- b

# Loop over all the relevant species.
model.avg.list <-list()
```

```
p.vals.vec <- rep(NA, times=length(species.vec))
coefs.vec <- rep(NA, times=length(species.vec))
cor.vec <- rep(NA, times=length(species.vec))
for (ii in 1:length(species.vec))
{
  # Obtain the subset of the data corresponding to this species.
  this.species <- species.vec[ii]
  pc.this.species <- subset(pc, Species==this.species)
  pc.this.species <- pc.this.species[ ,c(3,4,9)]
  print(this.species)

  # Table of counts for each class of cover value, by treatment group, for
  # this species.
  #print(tapply(pc.this.species$Cover.value, pc.this.species$Treatment, table))

  # Table of counts for each block, by treatment group, for this species.
  entries <- table(pc.this.species$Block, pc.this.species$Treatment)
  which.entries.miss <- which(t(entries)==0)
  which.entries.miss.ind <- which(entries==0, arr.ind=TRUE)

  # Obtain averages over the transects and plots.
  by_blockTrt.this.species <- group_by(pc.this.species, Block, Treatment)
  dat.avg.this.species <- summarise(by_blockTrt.this.species,
                                    y.avg=sum(Cover.value)/50)

 if (length(which.entries.miss) > 0)
  {
    for (jj in 1:length(which.entries.miss))
    {
      which.row <- which.entries.miss[jj]
      which.block <- toString(which.entries.miss.ind[jj,1])
      which.trt <- ifelse(test=(which.entries.miss.ind[jj,2]==1), yes='Biosolids',
                          no='Control')

    }
  }
  dat.avg.this.species$y.avg <- as.numeric(dat.avg.this.species$y.avg)
  print(dat.avg.this.species)




  }
```

```
## [1] "ALCE"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 13.90
## 2      1   Control 19.70
## 3      2 Biosolids  2.75
## 4      2   Control  2.55
```

```
## 5      3 Biosolids  0.10
## 6      3   Control  0.10
## 7      4   Control  0.05
## [1] "ANDI"
## Source: local data frame [4 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control  0.80
## 2      2   Control  3.40
## 3      3   Control  1.20
## 4      4   Control  1.15
## [1] "BRYO"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1   Control 40.60
## 2      2 Biosolids  0.70
## 3      2   Control 23.75
## 4      3   Control 31.15
## 5      4 Biosolids  1.05
## 6      4   Control 29.05
## [1] "HECO"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 28.30
## 2      1   Control 23.65
## 3      2 Biosolids 28.60
## 4      2   Control 28.90
## 5      3 Biosolids 49.05
## 6      3   Control 43.35
## 7      4 Biosolids 27.10
## 8      4   Control 27.65
## [1] "KOMA"
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids  1.70
## 2      1   Control  3.85
## 3      2 Biosolids  4.85
## 4      2   Control  7.75
## 5      3 Biosolids  0.40
## 6      3   Control  5.65
## 7      4 Biosolids  0.75
## 8      4   Control 10.40
## [1] "LITT"
```

```
## Source: local data frame [8 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 93.70
## 2      1   Control 30.30
## 3      2 Biosolids 82.85
## 4      2   Control 28.35
## 5      3 Biosolids 92.35
## 6      3   Control 46.30
## 7      4 Biosolids 86.15
## 8      4   Control 32.70
## [1] "POJU"
## Source: local data frame [6 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids  3.20
## 2      1   Control  0.30
## 3      2 Biosolids 24.95
## 4      2   Control  0.70
## 5      3   Control  0.20
## 6      4 Biosolids  1.25
## [1] "POPR"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 23.45
## 2      1   Control  0.15
## 3      2 Biosolids  9.75
## 4      3 Biosolids 26.85
## 5      3   Control  0.05
## 6      4 Biosolids 43.40
## 7      4   Control  0.30
## [1] "PSSP"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids 15.05
## 2      1   Control  0.95
## 3      2 Biosolids  6.50
## 4      2   Control  0.15
## 5      3 Biosolids  0.75
## 6      4 Biosolids  1.95
## 7      4   Control  0.40
## [1] "SOIL"
## Source: local data frame [8 x 3]
## Groups: Block [?]
```

```
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids  0.70
## 2      1   Control  5.20
## 3      2 Biosolids  2.05
## 4      2   Control  9.70
## 5      3 Biosolids  0.80
## 6      3   Control  2.15
## 7      4 Biosolids  0.50
## 8      4   Control  6.65
## [1] "TAOF"
## Source: local data frame [7 x 3]
## Groups: Block [?]
##
##    Block Treatment y.avg
##   <fctr>    <fctr> <dbl>
## 1      1 Biosolids  3.05
## 2      1   Control  0.10
## 3      2 Biosolids  0.20
## 4      3 Biosolids 11.30
## 5      3   Control  0.10
## 6      4 Biosolids  3.20
## 7      4   Control  0.10
```