ModBalsVolBoth.R

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```
library(ggplot2)
library(lme4)
```

```
## Loading required package: Matrix
```

```
library(nlme)
```

```
##
## Attaching package: 'nlme'
```

```
## The following object is masked from 'package:lme4':
##
##     lmList
```

```
library(lsmeans)
```

```
## Warning: package 'lsmeans' was built under R version 3.2.5
```

```
## Loading required package: estimability
```

```
## Warning: package 'estimability' was built under R version 3.2.5
```

```
library(lubridate)
```

```
## Warning: package 'lubridate' was built under R version 3.2.5
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
library(multcompView)
```

```
## Warning: package 'multcompView' was built under R version 3.2.5
```

```
library(car)
```

```
## Warning: package 'car' was built under R version 3.2.5
```

```
setwd("D:/Iowa State University/Debinski Lab/Nectar data/MAL")

balsvol15 <- read.csv("nectar analysis/data files/balsvol15.csv", header = T)
balsvol16 <- read.csv("nectar analysis/data files/balsvol16.csv", header = T)
balsvolboth <- rbind(balsvol15,balsvol16)
rm(balsvol15)
rm(balsvol16)

balsvolboth$lnvol <- log(balsvolboth$volume)
balsvolboth$year <- as.factor(year(balsvolboth$date))

cellN <- with(balsvolboth, table(treatment, year))
cellN
```

```
##          year
## treatment 2015 2016
##         C   31   85
##         H   61   83
```

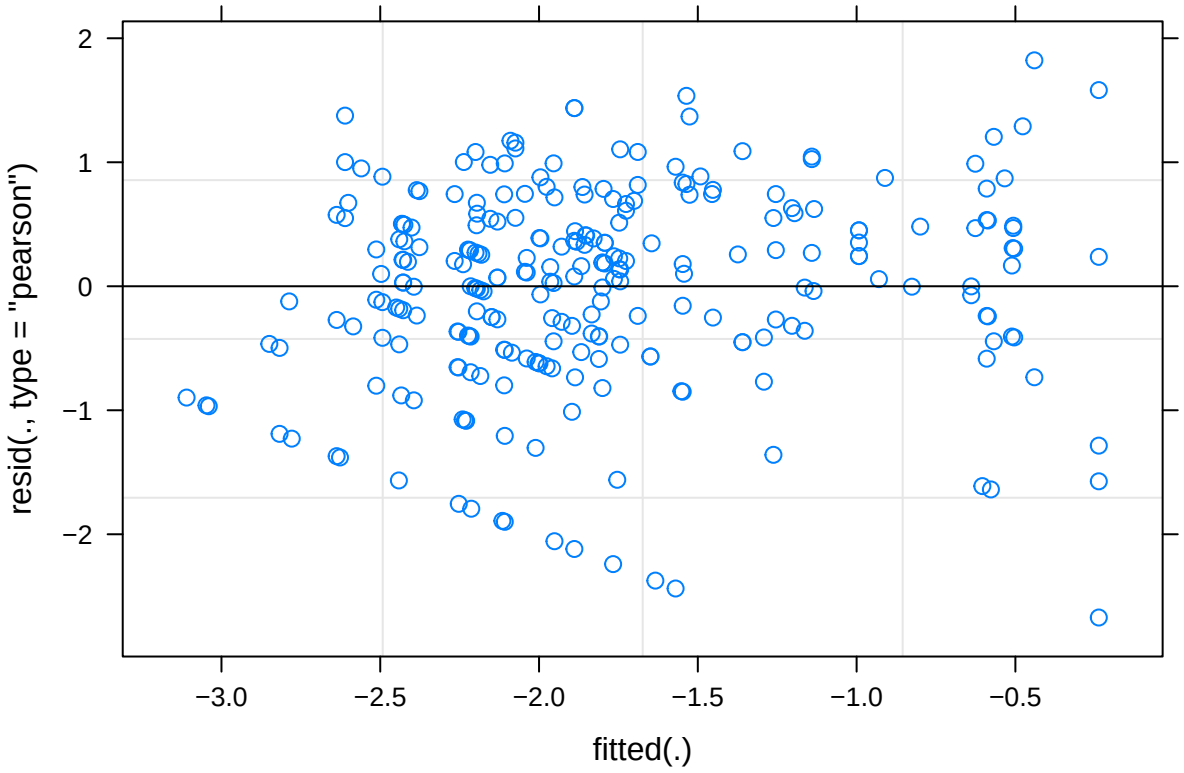
```
cellMean <- with(balsvolboth, tapply(volume, list(treatment, year), mean))
cellMean
```

```
##        2015      2016
## C 0.6404692 0.1659893
## H 0.4891207 0.1526835
```

```
# Model ln(volume), hypothesis test
  #modeled ln of volume because using volume itself doesn't give us good residuals
modlnvol <- lmer(lnvol ~ treatment * year + (1|plot/plant) + (1|year:date), data = balsvolboth)
summary(modlnvol)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: lnvol ~ treatment * year + (1 | plot/plant) + (1 | year:date)
##    Data: balsvolboth
##
## REML criterion at convergence: 685.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.2148 -0.5339  0.1369  0.6395  2.1926
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  plant:plot (Intercept) 0.0189   0.1375
##  year:date  (Intercept) 0.3615   0.6013
##  plot       (Intercept) 0.0664   0.2577
##  Residual               0.6905   0.8310
## Number of obs: 260, groups:  plant:plot, 53; year:date, 13; plot, 11
##
## Fixed effects:
##                     Estimate Std. Error t value
## (Intercept)          -1.1451     0.2979  -3.844
## treatmentH           -0.2698     0.2577  -1.047
## year2016             -1.1221     0.4029  -2.785
## treatmentH:year2016   0.3226     0.2450   1.317
##
## Correlation of Fixed Effects:
##             (Intr) trtmnH yr2016
## treatmentH  -0.522
## year2016    -0.642  0.275
## trtmnH:2016  0.389 -0.644 -0.404
```

```
plot(modlnvol)
```




```
#inflvol <- influence(modlnvol, obs = T)
#plot(inflvol, which = "cook", main = "Balsam Volume")

lnvol.grid <- ref.grid(modlnvol)
```

```
## Loading required namespace: lmerTest
```

```
summary(lnvol.grid)
```

```
##  treatment year prediction        SE    df
##  C         2015  -1.145129 0.2978907 18.10
##  H         2015  -1.414890 0.2738074 13.41
##  C         2016  -2.267259 0.3112989  9.75
##  H         2016  -2.214381 0.3095623  9.52
##
## Degrees-of-freedom method: satterthwaite
```

```
lnvol.treat <- lsmeans(lnvol.grid, "treatment")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
pairs(lnvol.treat)
```

```
##  contrast estimate       SE    df t.ratio p.value
##  C - H    0.108442 0.201902 11.33   0.537  0.6016
##
## Results are averaged over the levels of: year
```

```
lnvol.year <- lsmeans(lnvol.grid, "year")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
pairs(lnvol.year)
```

```
##  contrast     estimate        SE   df t.ratio p.value
##  2015 - 2016 0.9608109 0.3706638 7.61   2.592  0.0334
##
## Results are averaged over the levels of: treatment
```

```
int.vol <- pairs(lnvol.grid, by = "year")
int.voltable <- update(int.vol, by = NULL)
int.voltable
```

```
##  contrast year    estimate        SE    df t.ratio p.value
##  C - H    2015  0.26976118 0.2577379 25.80   1.047  0.3050
##  C - H    2016 -0.05287715 0.2123742 14.09  -0.249  0.8070
```

```
test(pairs(int.voltable), joint = T)
```

```
##  df1    df2     F p.value
##    1 102.92 1.735  0.1907
```

```
Anova(modlnvol, type = 3)
```

```
## Analysis of Deviance Table (Type III Wald chisquare tests)
##
## Response: lnvol
##                  Chisq Df Pr(>Chisq)
## (Intercept)    14.7773  1   0.000121 ***
## treatment       1.0955  1   0.295261
## year            7.7587  1   0.005345 **
## treatment:year  1.7348  1   0.187804
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```