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
```

```r
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)

balsvolboth$year <- as.factor(year(balsvolboth$date))

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

```
##          year
## treatment 2015 2016
##         C   29   85
##         H   59   83
```

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

```
##        2015      2016
## C 0.5028213 0.1659893
## H 0.4613251 0.1526835
```

```r
modvol <- lm(volume ~ treatment + year + treatment:year, data = balsvolboth)

volume.grid <- ref.grid(modvol)
summary(volume.grid)
```

```
##  treatment year prediction         SE  df
##  C         2015  0.5028213 0.06141489 252
##  H         2015  0.4613251 0.04305729 252
##  C         2016  0.1659893 0.03587263 252
##  H         2016  0.1526835 0.03630226 252
```

```r
lsmeans(volume.grid, "treatment")
```

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

```
##  treatment    lsmean         SE  df  lower.CL  upper.CL
##  C         0.3344053 0.03556204 252 0.2643686 0.4044420
##  H         0.3070043 0.02815930 252 0.2515467 0.3624618
##
## Results are averaged over the levels of: year
## Confidence level used: 0.95
```

```r
lsmeans(volume.grid, "year")
```

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

```
##  year    lsmean         SE  df  lower.CL  upper.CL
##  2015 0.4820732 0.03750240 252 0.4082152 0.5559313
##  2016 0.1593364 0.02551813 252 0.1090804 0.2095924
##
## Results are averaged over the levels of: treatment
## Confidence level used: 0.95
```

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

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

```
pairs(volume.treat)
```

```
##  contrast   estimate         SE  df t.ratio p.value
##  C - H    0.02740102 0.04536083 252   0.604  0.5463
##
## Results are averaged over the levels of: year
```

```
pairs.treat <- pairs(volume.treat)
test(pairs.treat, joint = T)
```

```
##  df1 df2     F p.value
##    1 252 0.365  0.5463
```

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

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

```
pairs(volume.year)
```

```
##  contrast     estimate         SE  df t.ratio p.value
##  2015 - 2016 0.3227368 0.04536083 252   7.115  <.0001
##
## Results are averaged over the levels of: treatment
```

```
pairs.year <- pairs(volume.year)
test(pairs.year, joint = T)
```

```
##  df1 df2      F p.value
##    1 252 50.622  <.0001
```

```
int.vol <- pairs(volume.grid, by = "year")
int.vol
```

```
## year = 2015:
##  contrast   estimate         SE  df t.ratio p.value
##  C - H    0.04149620 0.07500479 252   0.553  0.5806
##
## year = 2016:
##  contrast   estimate         SE  df t.ratio p.value
##  C - H    0.01330584 0.05103626 252   0.261  0.7945
```

```
int.voltable <- update(int.vol, by = NULL)
int.voltable
```

```
##  contrast year   estimate         SE  df t.ratio p.value
##  C - H    2015 0.04149620 0.07500479 252   0.553  0.5806
##  C - H    2016 0.01330584 0.05103626 252   0.261  0.7945
```

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

```
##  df1 df2     F p.value
##    1 252 0.097  0.7563
```

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

```
## Anova Table (Type III tests)
##
## Response: volume
##                 Sum Sq  Df F value    Pr(>F)
## (Intercept)     7.3320   1 67.0317 1.339e-14 ***
## treatment       0.0335   1  0.3061    0.5806
## year            2.4532   1 22.4281 3.644e-06 ***
## treatment:year  0.0106   1  0.0966    0.7563
## Residuals      27.5642 252
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
############################################################

modvol <- lmer(volume ~ treatment * year + (1|plant), data = balsvolboth)

volume.grid <- ref.grid(modvol)
```

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

```
summary(volume.grid)
```

```
##  treatment year prediction         SE    df
##  C         2015  0.5171059 0.06738559 89.06
##  H         2015  0.4665556 0.04802945 68.47
##  C         2016  0.1660616 0.04019951 57.26
##  H         2016  0.1557071 0.04014309 66.68
##
## Degrees-of-freedom method: satterthwaite
```

```
lsmeans(volume.grid, "treatment")
```

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

```
##  treatment    lsmean         SE    df  lower.CL  upper.CL
##  C         0.3415838 0.04042699 52.32 0.2604728 0.4226947
##  H         0.3111314 0.03348773 32.04 0.2429221 0.3793406
##
## Results are averaged over the levels of: year
## Degrees-of-freedom method: satterthwaite
## Confidence level used: 0.95
```

```
lsmeans(volume.grid, "year")
```

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

```
##  year    lsmean         SE    df  lower.CL  upper.CL
##  2015 0.4918308 0.04137525 81.34 0.4095123 0.5741493
##  2016 0.1608844 0.02840540 61.72 0.1040977 0.2176710
##
## Results are averaged over the levels of: treatment
## Degrees-of-freedom method: satterthwaite
## Confidence level used: 0.95
```

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

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

```
pairs(volume.treat)
```

```
##  contrast   estimate         SE    df t.ratio p.value
##  C - H    0.03045238 0.05249543 42.35    0.58  0.5649
##
## Results are averaged over the levels of: year
```

```
pairs.treat <- pairs(volume.treat)
test(pairs.treat, joint = T)
```

```
##  df1   df2     F p.value
##    1 42.35 0.337  0.5649
```

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

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

```
pairs(volume.year)
```

```
##  contrast     estimate         SE     df t.ratio p.value
##  2015 - 2016 0.3309464 0.04776806 164.71   6.928  <.0001
##
## Results are averaged over the levels of: treatment
```

```
pairs.year <- pairs(volume.year)
test(pairs.year, joint = T)
```

```
##  df1    df2  F p.value
##    1 164.71 48  <.0001
```

```
int.vol <- pairs(volume.grid, by = "year")
int.vol
```

```
## year = 2015:
##  contrast   estimate         SE    df t.ratio p.value
##  C - H    0.05055028 0.08275050 81.34   0.611  0.5430
##
## year = 2016:
##  contrast   estimate         SE    df t.ratio p.value
##  C - H    0.01035449 0.05681081 61.72   0.182  0.8560
```

```
int.voltable <- update(int.vol, by = NULL)
int.voltable
```

```
##  contrast year   estimate         SE    df t.ratio p.value
##  C - H    2015 0.05055028 0.08275050 81.34   0.611  0.5430
##  C - H    2016 0.01035449 0.05681081 61.72   0.182  0.8560
```

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

```
##  df1    df2     F p.value
##    1 164.71 0.177  0.6745
```

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

```
## Analysis of Deviance Table (Type III Wald chisquare tests)
##
## Response: volume
##                  Chisq Df Pr(>Chisq)
## (Intercept)    58.8877  1  1.669e-14 ***
## treatment       0.3732  1     0.5413
## year           21.3342  1  3.858e-06 ***
## treatment:year  0.1770  1     0.6739
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```