

Dermo Challenge Apoptosis Assay Data Analysis

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Load Packages

APOPTOSIS ASSAY Day 7

Load in data for each plot

#Load in the Data for each plot on a separate spreadsheet

```
APOP_PLOT3_P1_GATE <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT3.csv", header=TRUE)
APOP_PLOT8_GRANULAR_AGRANULAR <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT8.csv", header=TRUE)
APOP_PLOT4_GRANULAR_QUAD_PLOT <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT4.csv", header=TRUE)
APOP_PLOT7_AGRANULAR_QUAD_PLOT <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT7.csv", header=TRUE)
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT4_GATE_ADDED.csv", header=TRUE)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/PLOT7_GATE_ADDED.csv", header=TRUE)
```

#Remove empty rows

```
APOP_PLOT3_P1_GATE <- na.omit(APOP_PLOT3_P1_GATE)
APOP_PLOT8_GRANULAR_AGRANULAR <- na.omit(APOP_PLOT8_GRANULAR_AGRANULAR)
APOP_PLOT4_GRANULAR_QUAD_PLOT <- na.omit(APOP_PLOT4_GRANULAR_QUAD_PLOT)
APOP_PLOT7_AGRANULAR_QUAD_PLOT <- na.omit(APOP_PLOT7_AGRANULAR_QUAD_PLOT)
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED <- na.omit(APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED <- na.omit(APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED)
```

Remove percent symbol from columns

```
APOP_PLOT3_P1_GATE$P1_PERCENT_OF_THE_PLOT <- as.numeric(gsub("%", "", APOP_PLOT3_P1_GATE$P1_PERCENT_OF_THE_PLOT))
APOP_PLOT8_GRANULAR_AGRANULAR$P3_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT8_GRANULAR_AGRANULAR$P3_PERCENT_OF_THIS_PLOT))
APOP_PLOT8_GRANULAR_AGRANULAR$P4_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT8_GRANULAR_AGRANULAR$P4_PERCENT_OF_THIS_PLOT))
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_PERCENT_OF_THIS_PLOT))
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_PERCENT_OF_THIS_PLOT))
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LL_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LL_PERCENT_OF_THIS_PLOT))
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_PERCENT_OF_THIS_PLOT))
```

```
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_PERCENT_OF_THIS_PLOT))
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_PERCENT_OF_THIS_PLOT))
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LL_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LL_PERCENT_OF_THIS_PLOT))
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_PERCENT_OF_THIS_PLOT))
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED$PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED$PERCENT_OF_THIS_PLOT))
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED$PERCENT_OF_THIS_PLOT <- as.numeric(gsub("%", "", APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED$PERCENT_OF_THIS_PLOT))
```

Load in Data for the samples to remove

```
APOPTOSIS_Samples_Remove <- read.csv(file="../ANALYSIS_CSVs/APOPTOSIS_ASSAY/DAY7/APOPTOSIS_SAMPLES_REMOVE.csv", header=TRUE)
```

```
# Data Frame with bad samples removed
```

```
APOP_PLOT3_P1_GATE_BAD_REMOVED <- APOP_PLOT3_P1_GATE[!APOP_PLOT3_P1_GATE$SAMPLE_ID %in% APOPTOSIS_SampleID]
APOP_PLOT8_GRANULAR_AGRANULAR_BAD_REMOVED <- APOP_PLOT8_GRANULAR_AGRANULAR[!APOP_PLOT8_GRANULAR_AGRANULAR$SAMPLE_ID %in% APOPTOSIS_SampleID]
APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT[!APOP_PLOT4_GRANULAR_QUAD_PLOT$SAMPLE_ID %in% APOPTOSIS_SampleID]
APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT[!APOP_PLOT7_AGRANULAR_QUAD_PLOT$SAMPLE_ID %in% APOPTOSIS_SampleID]
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED[!APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED$SAMPLE_ID %in% APOPTOSIS_SampleID]
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED[!APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED$SAMPLE_ID %in% APOPTOSIS_SampleID]
```

Arc sine Percentage data

```
# NOTE: NA's produced whenever the percentages were above 100%
```

```
APOP_PLOT3_P1_GATE$Arcsine<- transf.arcsin(APOP_PLOT3_P1_GATE$P1_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT8_GRANULAR_AGRANULAR$P3_Arcsine <- transf.arcsin(APOP_PLOT8_GRANULAR_AGRANULAR$P3_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT8_GRANULAR_AGRANULAR$P4_Arcsine <- transf.arcsin(APOP_PLOT8_GRANULAR_AGRANULAR$P4_PERCENT_OF_THE_PLOT*0.01)
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LL_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_PERCENT_OF_THE_PLOT*0.01)
```

```
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LL_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_PERCENT_OF_THE_PLOT*0.01)
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED$Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED$P4_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED$Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED$P4_PERCENT_OF_THE_PLOT*0.01)
```

```
# NOTE: NA's produced whenever the percentages were above 100%
```

```
APOP_PLOT3_P1_GATE_BAD_REMOVED$Arcsine<- transf.arcsin(APOP_PLOT3_P1_GATE_BAD_REMOVED$P1_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT8_GRANULAR_AGRANULAR_BAD_REMOVED$P3_Arcsine <- transf.arcsin(APOP_PLOT8_GRANULAR_AGRANULAR_BAD_REMOVED$P3_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT8_GRANULAR_AGRANULAR_BAD_REMOVED$P4_Arcsine <- transf.arcsin(APOP_PLOT8_GRANULAR_AGRANULAR_BAD_REMOVED$P4_PERCENT_OF_THE_PLOT*0.01)
```

```
APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UL_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LL_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_PERCENT_OF_THE_PLOT*0.01)
```

```
APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UL_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LL_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LL_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_PERCENT_OF_THE_PLOT*0.01)
```

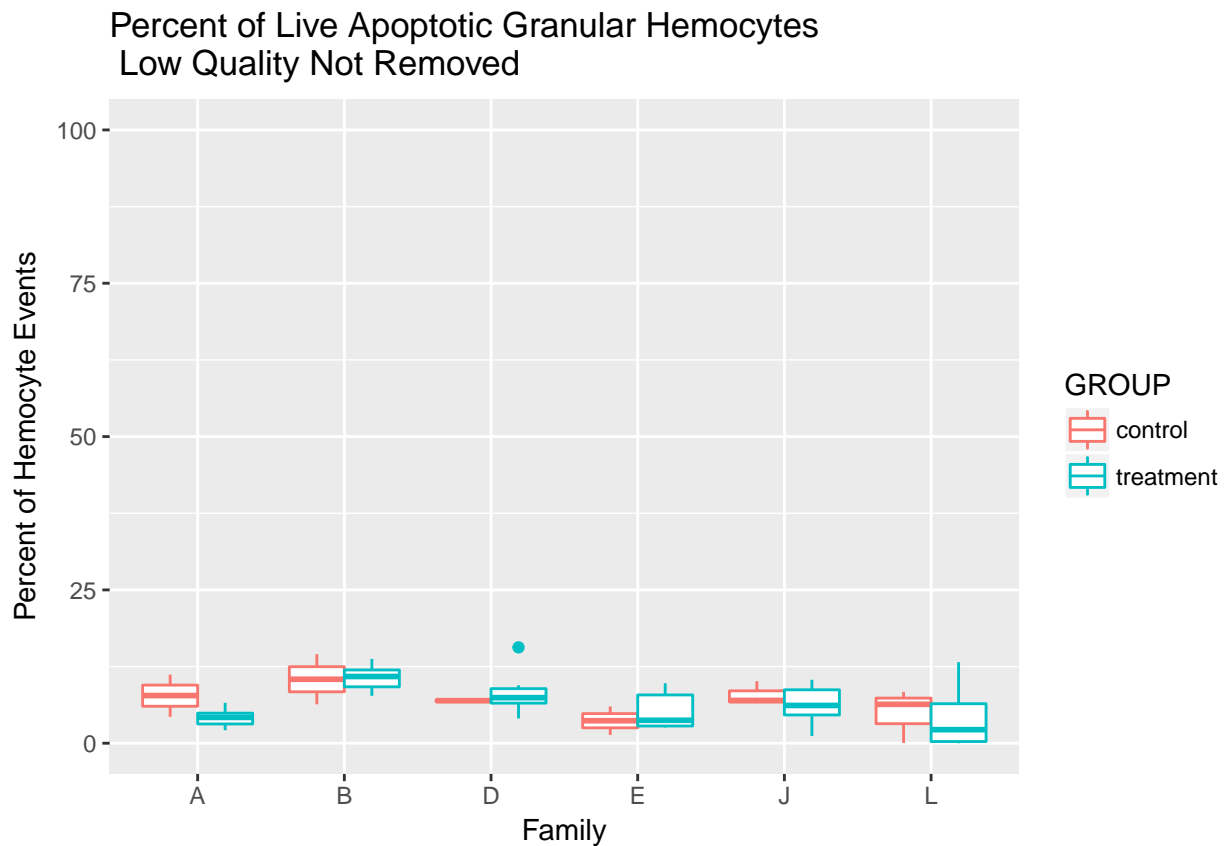
```
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$Arcsine <- transf.arcsin(APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$P4_PERCENT_OF_THE_PLOT*0.01)
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$Arcsine <- transf.arcsin(APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$P4_PERCENT_OF_THE_PLOT*0.01)
```

% LIVE apoptotic granular hemocytes (PLOT4, Q2-LR)

Percent LIVE apoptotic granular hemocytes (PLOT4, Q2-LR)

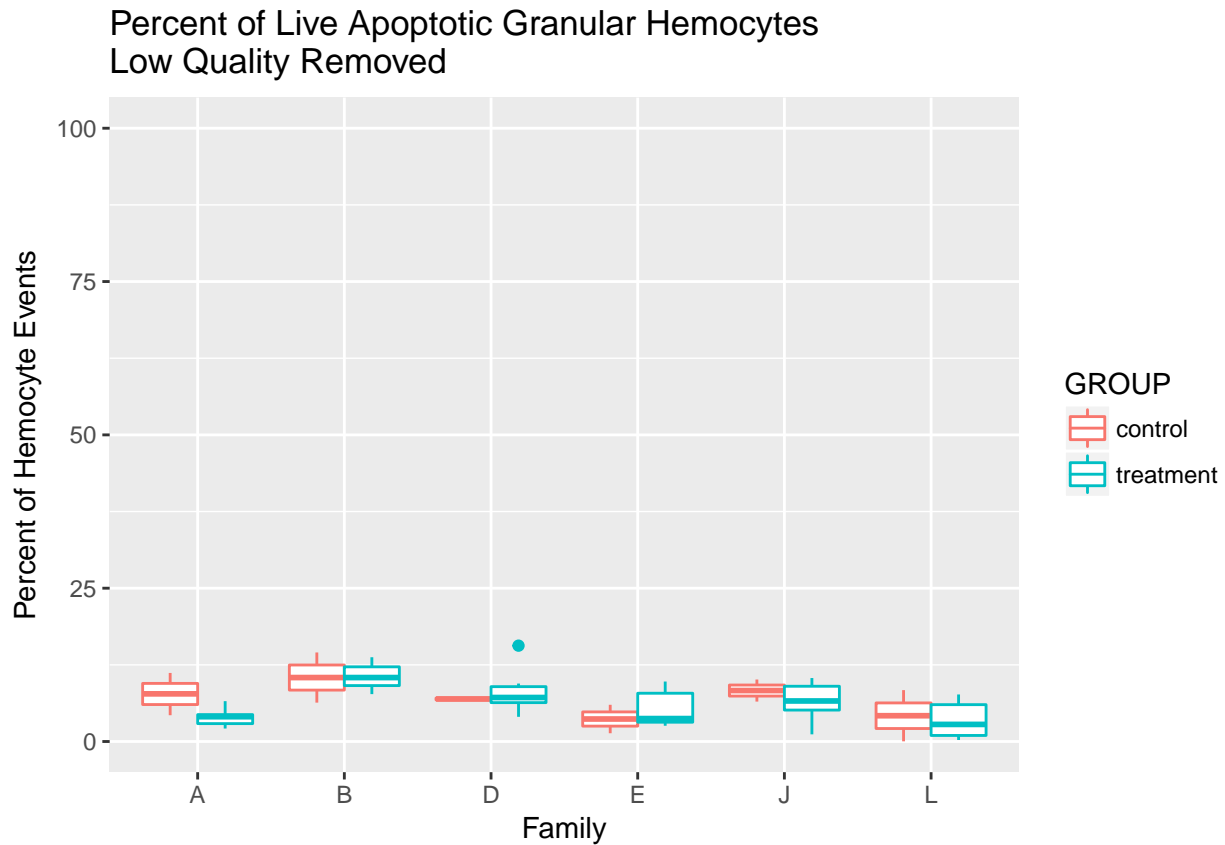
```
APOP_live_apoptotic_granular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT4_GRANULAR_QUAD_PLOT, aes(x=FAMILY, y=PERCENT)) +
  xlab("Family") + ylab("Percent of Hemocyte Events") + ylim(0,100)
```

```
APOP_live_apoptotic_granular_BAD_NOT_REMOVED
```



```
APOP_live_apoptotic_granular_BAD_REMOVED <- ggplot(data= APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, aes(
  x=FAMILY, y=PERCENT)) + ylab("Percent of Hemocyte Events") + ylim(0,100)
```

```
APOP_live_apoptotic_granular_BAD_REMOVED
```



FAMILY A

```
APOP_PLOT_4_granular_FAMILY_A <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="A")
```

```
## Warning: package 'bindrcpp' was built under R version 3.4.4
```

```
APOP_PLOT_4_granular_FAMILY_A_AOV <- aov(APOP_PLOT_4_granular_FAMILY_A$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_A$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_A_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A$GROUP  1  0.01358  0.013577    6.941  0.025 *
## Residuals                        10  0.01956  0.001956
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="A")
APOP_PLOT_4_granular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP  1  0.01439  0.014394
## Residuals                        9  0.01866  0.002073
##                               F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP    6.944  0.0271 *
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FAMILY B

```
APOP_PLOT_4_granular_FAMILY_B <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="B")
```

```
APOP_PLOT_4_granular_FAMILY_B_AOV <- aov(APOP_PLOT_4_granular_FAMILY_B$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_B$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_B_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B$GROUP  1 0.000152 0.0001523   0.072  0.795
## Residuals                            8 0.016816 0.0021020
```

```
APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="B")
APOP_PLOT_4_granular_FAMILY_B_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_B_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq   Mean Sq
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP  1 0.000105 0.0001049
## Residuals                                         7 0.016682 0.0023832
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP  0.044   0.84
## Residuals
```

FAMILY D

```
APOP_PLOT_4_granular_FAMILY_D <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="D")
```

```
APOP_PLOT_4_granular_FAMILY_D_AOV <- aov(APOP_PLOT_4_granular_FAMILY_D$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_D$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_D_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D$GROUP  1 0.000641 0.000641   0.186  0.679
## Residuals                            7 0.024111 0.003444
```

```
APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="D")
APOP_PLOT_4_granular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_D_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq   Mean Sq
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP  1 0.000555 0.000555
## Residuals                                         6 0.024063 0.004011
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP  0.138   0.723
## Residuals
```

FAMILY E

```
APOP_PLOT_4_granular_FAMILY_E <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="E")
```

```
APOP_PLOT_4_granular_FAMILY_E_AOV <- aov(APOP_PLOT_4_granular_FAMILY_E$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_E$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_E_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E$GROUP  1 0.00302 0.003024   0.7   0.425
```

```
## Residuals                      9 0.03889 0.004322
APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="E")
APOP_PLOT_4_granular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_E_AOV_BAD_REMOVED)

##                               Df  Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP  1 0.00337 0.003369
## Residuals                                         7 0.03377 0.004825
##                               F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP  0.698  0.431
## Residuals
```

FAMILY J

```
APOP_PLOT_4_granular_FAMILY_J <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="J")
APOP_PLOT_4_granular_FAMILY_J_AOV <- aov(APOP_PLOT_4_granular_FAMILY_J$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED)
summary(APOP_PLOT_4_granular_FAMILY_J_AOV)

##                               Df  Sum Sq  Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J$GROUP  1 0.00301 0.003008    0.81  0.387
## Residuals                          11 0.04085 0.003714
APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="J")
APOP_PLOT_4_granular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_J_AOV_BAD_REMOVED)

##                               Df  Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP  1 0.00264 0.002637
## Residuals                                         9 0.03916 0.004351
##                               F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP  0.606  0.456
## Residuals
```

FAMILY L

```
APOP_PLOT_4_granular_FAMILY_L <- APOP_PLOT4_GRANULAR_QUAD_PLOT %>% filter(FAMILY=="L")
APOP_PLOT_4_granular_FAMILY_L_AOV <- aov(APOP_PLOT_4_granular_FAMILY_L$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED)
summary(APOP_PLOT_4_granular_FAMILY_L_AOV)

##                               Df  Sum Sq  Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_L$GROUP  1 0.00215 0.002148    0.127  0.728
## Residuals                          11 0.18628 0.016934
APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="L")
APOP_PLOT_4_granular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$Q2.LR_Arcsine ~ APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP)
summary(APOP_PLOT_4_granular_FAMILY_L_AOV_BAD_REMOVED)

##                               Df  Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP  1 0.00026 0.000265
## Residuals                                         7 0.09139 0.013055
##                               F value Pr(>F)
```

```
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP    0.02  0.891
## Residuals
```

TWO WAY ANOVA of granular apoptotic

```
APOP_PLOT_4_granular_TWO_WAY_AOV <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP +
Anova(APOP_PLOT_4_granular_TWO_WAY_AOV, type="III")
```

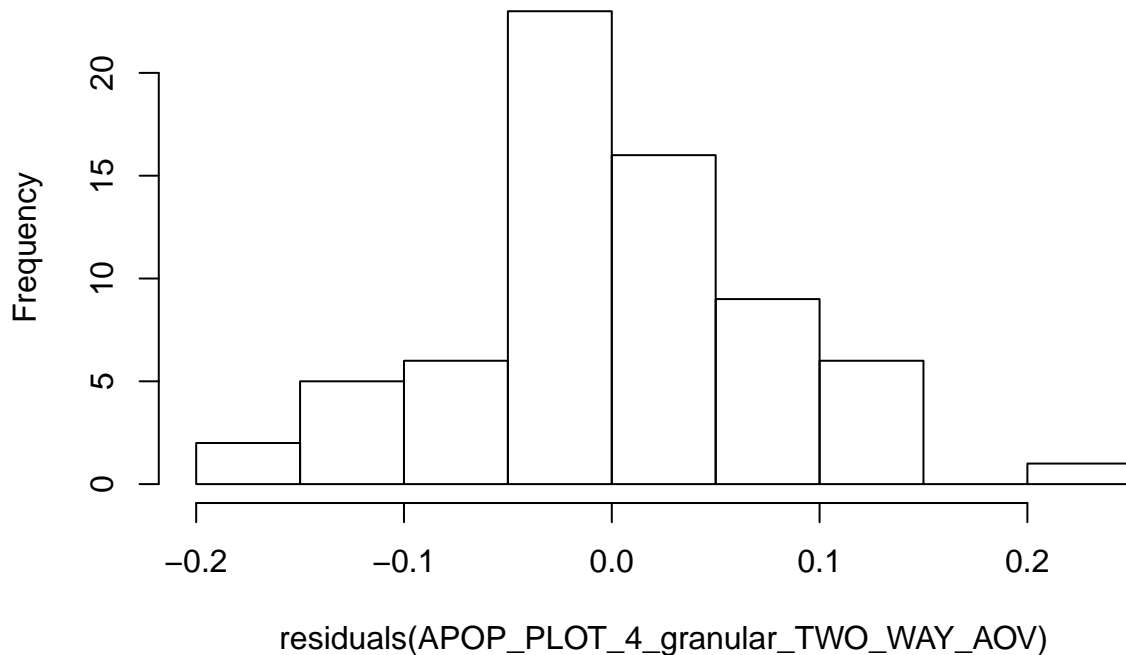
```
## Anova Table (Type II tests)
##
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_Arcsine
##              Sum Sq Df F value    Pr(>F)
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP  0.00382  1  0.6746    0.4147
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY 0.18589  5  6.5688 5.984e-05 ***
## Residuals                0.34524 61
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_PLOT_4_granular_TWO_WAY_AOV) #produces the overall p-value and r squared
```

```
##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.LR_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP +
##     APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.161646 -0.036986 -0.005016  0.047921  0.211104
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.2326651   0.0272899    8.526 5.51e-12 ***
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUPtreatment -0.0180971   0.0220342   -0.821 0.414664
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYB      0.1123507   0.0322308    3.486 0.000915 ***
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYD      0.0636212   0.0331793    1.917 0.059861 .
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYE     -0.0008313   0.0314390   -0.026 0.978991
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYJ      0.0364005   0.0301194    1.209 0.231504
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYL     -0.0536973   0.0301194   -1.783 0.079593 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07523 on 61 degrees of freedom
## Multiple R-squared:  0.3536, Adjusted R-squared:  0.2901
## F-statistic: 5.562 on 6 and 61 DF,  p-value: 0.0001191
```

```
#checking model assumptions, should be approximately normally distributed
hist(residuals(APOP_PLOT_4_granular_TWO_WAY_AOV))
```

Histogram of residuals(APOP_PLOT_4_granular_TWO_WAY_AOV)



```
# Bad samples removed
APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_REMOVED <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine ~
Anova(APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_REMOVED, type="II")
```

```
## Anova Table (Type II tests)
##
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine
##
##               Sum Sq Df F value
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.001181   1  0.2422
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.147054   5  6.0303
## Residuals                                0.243859  50
##
##               Pr(>F)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.6247616
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.0001929 ***
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_REMOVED)
```

```
##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine ~
##     APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY,
##     data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED)
##
## Residuals:
```

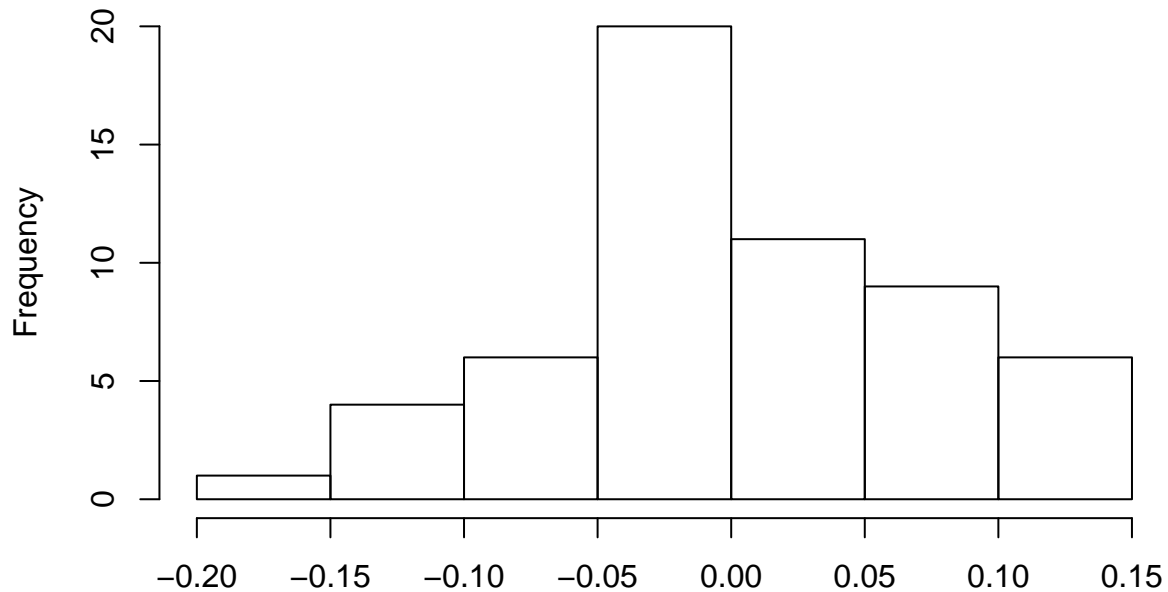


```

##      Min      1Q      Median      3Q      Max
## -0.156785 -0.035208 -0.008663  0.050641  0.128322
##
## Coefficients:
##                                     Estimate
## (Intercept)                       0.2261910
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment -0.0108772
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB         0.1113887
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD         0.0628110
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE         0.0003187
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ         0.0406543
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL        -0.0520848
##                                     Std. Error
## (Intercept)                       0.0264903
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment  0.0221011
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB         0.0314092
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD         0.0324543
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE         0.0314092
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ         0.0298462
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL         0.0314092
##                                     t value Pr(>|t|)
## (Intercept)                       8.539 2.47e-11
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment -0.492 0.624762
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB         3.546 0.000859
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD         1.935 0.058611
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE         0.010 0.991943
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ         1.362 0.179264
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL        -1.658 0.103525
##
## (Intercept) ***
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment ***
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB ***
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD .
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06984 on 50 degrees of freedom
## Multiple R-squared:  0.3777, Adjusted R-squared:  0.303
## F-statistic: 5.057 on 6 and 50 DF,  p-value: 0.0004028
##
## checking model assumptions
hist(residuals(APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_REMOVED))

```

ogram of residuals(APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_RE



residuals(APOP_PLOT_4_granular_TWO_WAY_AOV_BAD_REMOVED)

```
# INTERACTION TERM ADDED (using lm model)
APOP_PLOT_4_granular_hemocytetes_INTERACTION_aov <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Ar
Anova(APOP_PLOT_4_granular_hemocytetes_INTERACTION_aov, type="II") # effect of Family is significant, but

## Anova Table (Type II tests)
##
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```

## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_4_granular_hemocytes_INTERACTION_aov)

##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.LR_Arcsine ~
##      APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##      data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##      weights = NULL)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.142269 -0.040523 -0.000724  0.054220  0.138182
##
## Coefficients:
##
## (Intercept)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
##
## (Intercept)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
##
## (Intercept)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment

```

```

## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
##
## (Intercept)
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
##
## (Intercept)
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtreatment
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYB:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYD:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYE:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYJ:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILYL:APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$GROUPtre
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07051 on 45 degrees of freedom
## Multiple R-squared:  0.4291, Adjusted R-squared:  0.2895
## F-statistic: 3.074 on 11 and 45 DF, p-value: 0.003765

# Mean separation for main factor with lsmeans
lsmeans = lsmeans::lsmeans
APOP_PLOT_4_granular_hemocytes_INTERACTION_leastsquare <- lsmeans(APOP_PLOT_4_granular_hemocytes_INTERA
cld(APOP_PLOT_4_granular_hemocytes_INTERACTION_leastsquare, alpha=0.05, Letters=letters)

## APOP_PLOT4 GRANULAR QUAD PLOT BAD REMOVED$FAMILY      lsmean      SE df
## A      0.1961286 0.02492861 45
## B      0.1961286 0.02492861 45
## D      0.2367400 0.02386733 45
## E      0.2367400 0.02386733 45
## J      0.2367400 0.02386733 45
## L      0.2635365 0.01824588 45
## lower.CL upper.CL .group
## 0.1459198 0.2463374 a
## 0.1459198 0.2463374 a
## 0.1886687 0.2848113 ab
## 0.1886687 0.2848113 ab
## 0.1886687 0.2848113 ab
## 0.2267874 0.3002856 b
##

```

```
## Results are averaged over the levels of: APOP_PLOT4 GRANULAR QUAD_PLOT_BAD_REMOVED$GROUP
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05
```

One Way ANOVA of Differences between Families

```
APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE <- APOP_PLOT4 GRANULAR QUAD_PLOT_BAD_REMOVED[!grep(
APOP_PLOT_4_granular_hemocytes_oneway_aov <- aov(APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$Q
summary(APOP_PLOT_4_granular_hemocytes_oneway_aov)
```

```
##                                     Df Sum Sq
## APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  5 0.1234
## Residuals                                     38 0.1567
##                                     Mean Sq
## APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.024676
## Residuals                                     0.004122
##                                     F value
## APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  5.986
## Residuals
##                                     Pr(>F)
## APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.000354 ***
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

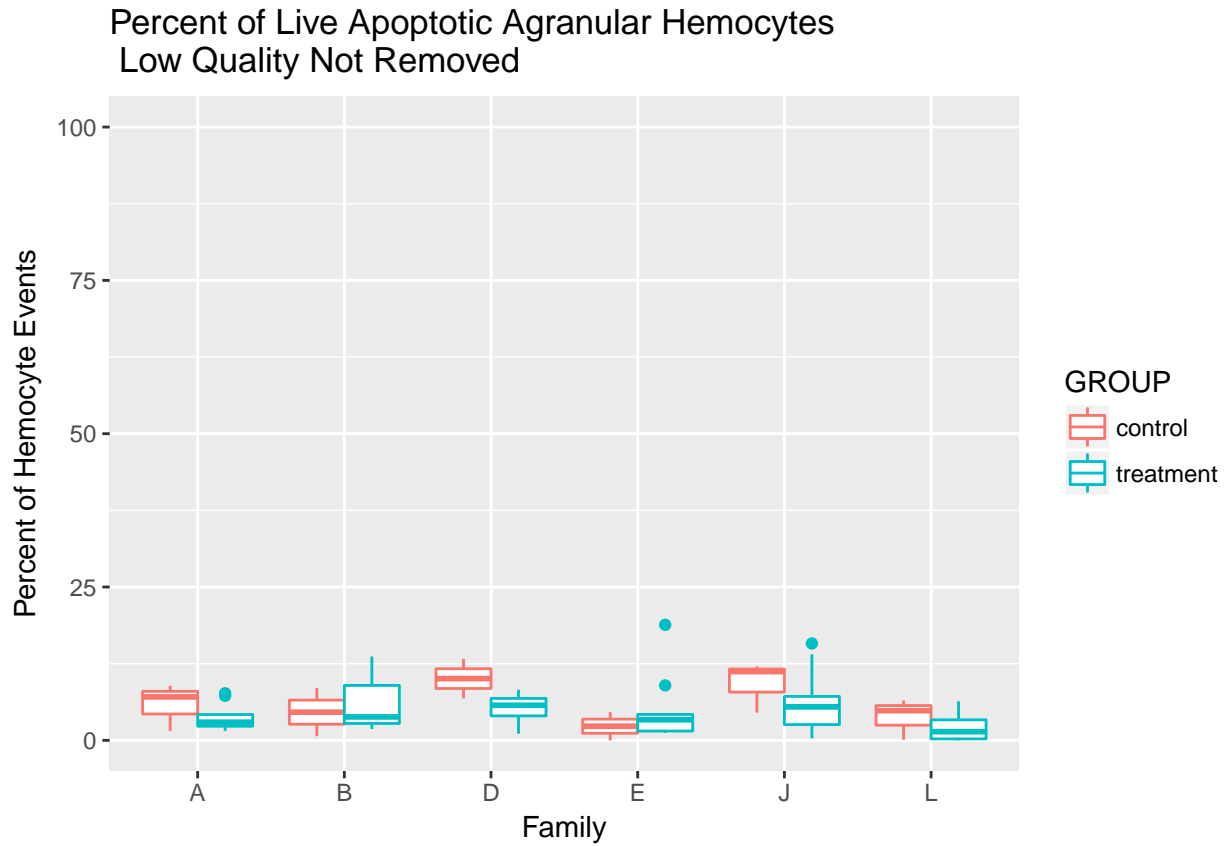
```
TukeyHSD(APOP_PLOT_4_granular_hemocytes_oneway_aov)
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$Q2.LR_Arcsine ~ APOP_PLOT_4_
##
## $`APOP_PLOT_4_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY`
##      diff      lwr      upr      p adj
## B-A  0.13481580  0.03512765  0.2345039522 0.0030377
## D-A  0.08952292 -0.01450151  0.1935473473 0.1267722
## E-A  0.03226255 -0.06742561  0.1319506993 0.9243084
## J-A  0.05451846 -0.03907600  0.1481129162 0.5103932
## L-A -0.02758463 -0.12727278  0.0721035213 0.9599896
## D-B -0.04529288 -0.15245442  0.0618686655 0.8001434
## E-B -0.10255325 -0.20551073  0.0004042288 0.0514144
## J-B -0.08029734 -0.17736659  0.0167719010 0.1552369
## L-B -0.16240043 -0.26535791 -0.0594429493 0.0004127
## E-D -0.05726037 -0.16442192  0.0499011705 0.6016887
## J-D -0.03500446 -0.13652191  0.0665129813 0.9032753
## L-D -0.11710755 -0.22426910 -0.0099460075 0.0252225
## J-E  0.02225591 -0.07481334  0.1193251539 0.9822508
## L-E -0.05984718 -0.16280466  0.0431103036 0.5126743
## L-J -0.08210309 -0.17917233  0.0149661573 0.1388098
```

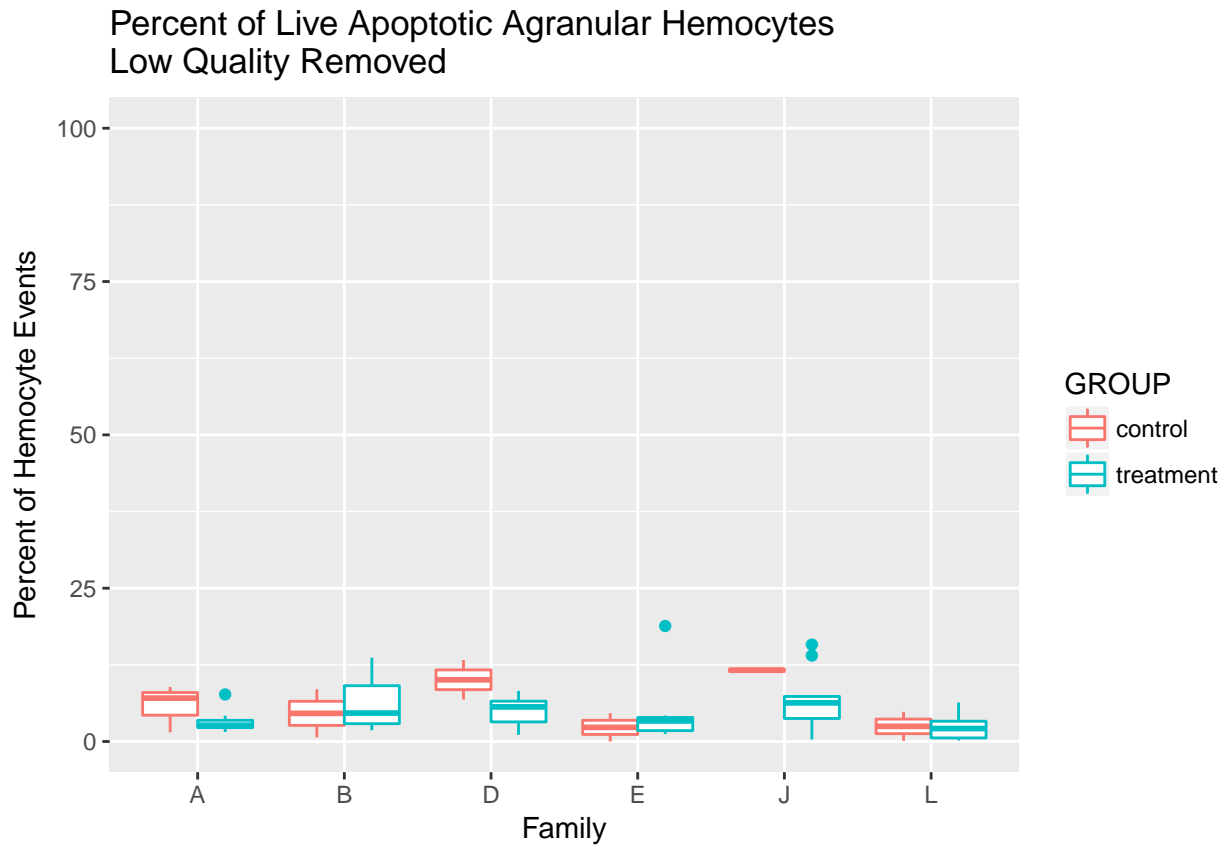
% LIVE apoptotic agranular hemocytes (PLOT 7, Q1-LR)

Percent LIVE apoptotic agranular hemocytes (PLOT7, Q1-LR)

```
APOP_live_apoptotic_Agranular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT7_AGRANULAR_QUAD_PLOT, aes(x=FAMILY, y=PERCENT))  
APOP_live_apoptotic_Agranular_BAD_NOT_REMOVED
```



```
APOP_live_apoptotic_Agranular_BAD_REMOVED <- ggplot(data= APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED, aes(x=FAMILY, y=PERCENT)) +  
  xlab("Family") + ylab("Percent of Hemocyte Events") + ylim(0,100)  
APOP_live_apoptotic_Agranular_BAD_REMOVED
```



FAMILY A

```
APOP_PLOT_7_agranular_FAMILY_A <- APOP_PLOT7_AGRANULAR_QUAD_PLOT %>% filter(FAMILY=="A")
```

```
APOP_PLOT_7_agranular_FAMILY_A_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_A$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_A$GROUP)
summary(APOP_PLOT_7_agranular_FAMILY_A_AOV)
```

```
##                                Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A$GROUP  1 0.00432 0.004324    1.011  0.338
## Residuals                        10 0.04276 0.004276
```

```
APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="A")
APOP_PLOT_7_agranular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_agranular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##                                Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP  1 0.00647 0.006467    1.679  0.227
## Residuals                        9 0.03466 0.003851
```

FAMILY B

```
##                                Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_B$GROUP  1 0.00283 0.002827    0.292  0.603
```

```
## Residuals                8 0.07734 0.009667
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP  1 0.00421 0.004207
## Residuals                7 0.07177 0.010253
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP    0.41  0.542
## Residuals
```

FAMILY D

```
APOP_PLOT_7_agranular_FAMILY_D <- APOP_PLOT7_AGRANULAR_QUAD_PLOT %>% filter(FAMILY=="D")
```

```
APOP_PLOT_7_agranular_FAMILY_D_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_D$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_D_AOV)
summary(APOP_PLOT_7_agranular_FAMILY_D_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D$GROUP  1 0.01432 0.01432  3.027  0.125
## Residuals                7 0.03311 0.00473
```

```
APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="D")
APOP_PLOT_7_agranular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_D_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_agranular_FAMILY_D_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP  1 0.01585 0.01585
## Residuals                6 0.03114 0.00519
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP    3.054  0.131
## Residuals
```

FAMILY E

```
APOP_PLOT_7_agranular_FAMILY_E <- APOP_PLOT7_AGRANULAR_QUAD_PLOT %>% filter(FAMILY=="E")
```

```
APOP_PLOT_7_agranular_FAMILY_E_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_E$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_E_AOV)
summary(APOP_PLOT_7_agranular_FAMILY_E_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E$GROUP  1 0.01485 0.01485  1.111  0.319
## Residuals                9 0.12025 0.01336
```

```
APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="E")
APOP_PLOT_7_agranular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_E_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_agranular_FAMILY_E_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP  1 0.01347 0.01348
## Residuals                7 0.10284 0.01469
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP    0.917  0.37
## Residuals
```


FAMILY J

```
APOP_PLOT_7_agranular_FAMILY_J <- APOP_PLOT7_AGRANULAR_QUAD_PLOT %>% filter(FAMILY=="J")
```

```
APOP_PLOT_7_agranular_FAMILY_J_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_J$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_J_AOV)
summary(APOP_PLOT_7_agranular_FAMILY_J_AOV)
```

```
##                                Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J$GROUP  1 0.0127 0.01270    1.096   0.318
## Residuals                          11 0.1274 0.01158
```

```
APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="J")
APOP_PLOT_7_agranular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_J_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_agranular_FAMILY_J_AOV_BAD_REMOVED)
```

```
##                                Df Sum Sq Mean Sq F value
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  1 0.0176 0.01760    1.664
## Residuals                                          9 0.0952 0.01058
##                                                    Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  0.229
## Residuals
```

FAMILY L

```
APOP_PLOT_7_agranular_FAMILY_L <- APOP_PLOT7_AGRANULAR_QUAD_PLOT %>% filter(FAMILY=="L")
```

```
APOP_PLOT_7_agranular_FAMILY_L_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_L$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_L_AOV)
summary(APOP_PLOT_7_agranular_FAMILY_L_AOV)
```

```
##                                Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L$GROUP  1 0.00588 0.005882    0.59   0.458
## Residuals                          11 0.10961 0.009965
```

```
APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED %>% filter(FAMILY=="L")
APOP_PLOT_7_agranular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$Q1.LR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_L_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_agranular_FAMILY_L_AOV_BAD_REMOVED)
```

```
##                                Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  1 0.00017 0.000169
## Residuals                                          7 0.05306 0.007580
##                                                    F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  0.022   0.886
## Residuals
```

TWO WAY ANOVA

```
APOP_PLOT_7_agranular_TWO_WAY_AOV <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_Arcsine ~ APOP_PLOT7_AGRANULAR_FAMILY_J | APOP_PLOT7_AGRANULAR_FAMILY_L)
Anova(APOP_PLOT_7_agranular_TWO_WAY_AOV, type="II") #significant family effect
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_Arcsine
```

```
##                                Sum Sq Df F value Pr(>F)
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP 0.00837 1 0.9171 0.3420
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY 0.11327 5 2.4809 0.0413 *
## Residuals 0.55701 61
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_7_agranular_TWO_WAY_AOV) # p-value overall is significant

##
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.LR_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP +
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT7_AGRANULAR_QUAD_PLOT)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.208061 -0.057807  0.001519  0.062035  0.267726
##
## Coefficients:
##                                Estimate Std. Error t value
## (Intercept)                   0.21904    0.03466   6.319
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment -0.02680    0.02799  -0.958
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB         0.02510    0.04094   0.613
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD         0.04606    0.04214   1.093
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE        -0.01098    0.03993  -0.275
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ         0.04784    0.03826   1.251
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL        -0.06685    0.03826  -1.747
##                                Pr(>|t|)
## (Intercept)                   3.38e-08 ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment  0.3420
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB         0.5421
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD         0.2787
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE         0.7842
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ         0.2159
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL         0.0856 .
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09556 on 61 degrees of freedom
## Multiple R-squared:  0.1791, Adjusted R-squared:  0.09838
## F-statistic: 2.218 on 6 and 61 DF, p-value: 0.05314

APOP_PLOT_7_agranular_TWO_WAY_AOV_BAD_REMOVED <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Ar
Anova(APOP_PLOT_7_agranular_TWO_WAY_AOV_BAD_REMOVED, type="II") # effect of family is significant

## Anova Table (Type II tests)
##
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine
##                                Sum Sq Df F value
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.00404 1 0.4563
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.10530 5 2.3801
## Residuals                                0.44240 50
##                                Pr(>F)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.50245
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.05166 .
## Residuals
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT7_agranular_TWO_WAY_AOV_BAD_REMOVED)

##
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine ~
##      APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAM
##      data = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.201897 -0.056630  0.001492  0.054568  0.272866
##
## Coefficients:
##                                     Estimate
## (Intercept)                        0.20685
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.02011
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.03831
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.05002
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE        -0.01062
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.07263
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -0.05639
##                                     Std. Error
## (Intercept)                        0.03568
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment  0.02977
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.04231
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.04371
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.04231
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.04020
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         0.04231
##                                     t value Pr(>|t|)
## (Intercept)                        5.797 4.51e-07
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.676  0.5025
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.906  0.3695
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         1.144  0.2579
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE        -0.251  0.8027
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         1.807  0.0768
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -1.333  0.1886
##
## (Intercept)                        ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09406 on 50 degrees of freedom
## Multiple R-squared:  0.1967, Adjusted R-squared:  0.1003
## F-statistic: 2.041 on 6 and 50 DF,  p-value: 0.07737
```

```
# INTERACTION TERM ADDED
```

```
APOP_PLOT_7_agranular_INTERACTION_aov <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine ~  
Anova(APOP_PLOT_7_agranular_INTERACTION_aov, type="II") #family is significant, but the interaction and
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine
```

```
##
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## Residuals
```

```
##
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## Residuals
```

```
##
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## Residuals
```

```
##
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## Residuals
```

```
##
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
```

```
## Residuals
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_PLOT_7_agranular_INTERACTION_aov)
```

```
##
```

```
## Call:
```

```
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.LR_Arcsine ~
```

```
##     APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$G
```

```
##     APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$
```

```
##
```

```
## Residuals:
```

```
##      Min      1Q   Median      3Q      Max
```

```
## -0.186698 -0.060222 -0.004472  0.048913  0.247715
```

```
##
```

```
## Coefficients:
```

```
##
```

```
## (Intercept)
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
```

```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
```



```
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPt:
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPt:
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPt:
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPt:
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPt:
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09294 on 45 degrees of freedom
## Multiple R-squared:  0.2943, Adjusted R-squared:  0.1218
## F-statistic: 1.706 on 11 and 45 DF,  p-value: 0.1029

APOP_PLOT_7_agranular_INTERACTION_aov_lsmeans<- lsmeans(APOP_PLOT_7_agranular_INTERACTION_aov, "APOP_PL
cld(APOP_PLOT_7_agranular_INTERACTION_aov_lsmeans, alpha=0.05, Letters=letters) #each family is differe

## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY      lsmean      SE df
## A                0.1773792 0.03285803 45
## B                0.1773792 0.03285803 45
## D                0.2045999 0.03145917 45
## E                0.2045999 0.03145917 45
## J                0.2045999 0.03145917 45
## L                0.2092304 0.02404962 45
## lower.CL upper.CL .group
## 0.1111997 0.2435587  a
## 0.1111997 0.2435587  a
## 0.1412378 0.2679619  a
## 0.1412378 0.2679619  a
## 0.1412378 0.2679619  a
## 0.1607920 0.2576688  a
##
## Results are averaged over the levels of: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05

APOP_PLOT_7_agranular_INTERACTION_aov_lsmeans_group <- lsmeans(APOP_PLOT_7_agranular_INTERACTION_aov, "
cld(APOP_PLOT_7_agranular_INTERACTION_aov_lsmeans_group, alpha=0.05, Letters=letters) #control and trea

## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP      lsmean      SE df
## control                0.1773792 0.03285803 45
## treatment              0.2152169 0.02956353 45
## lower.CL upper.CL .group
## 0.1111997 0.2435587  a
## 0.1556729 0.2747609  a
##
## Results are averaged over the levels of: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

One Way ANOVA of Differences between Families

% LIVE apoptotic granular and agranular hemocytes

Graphing

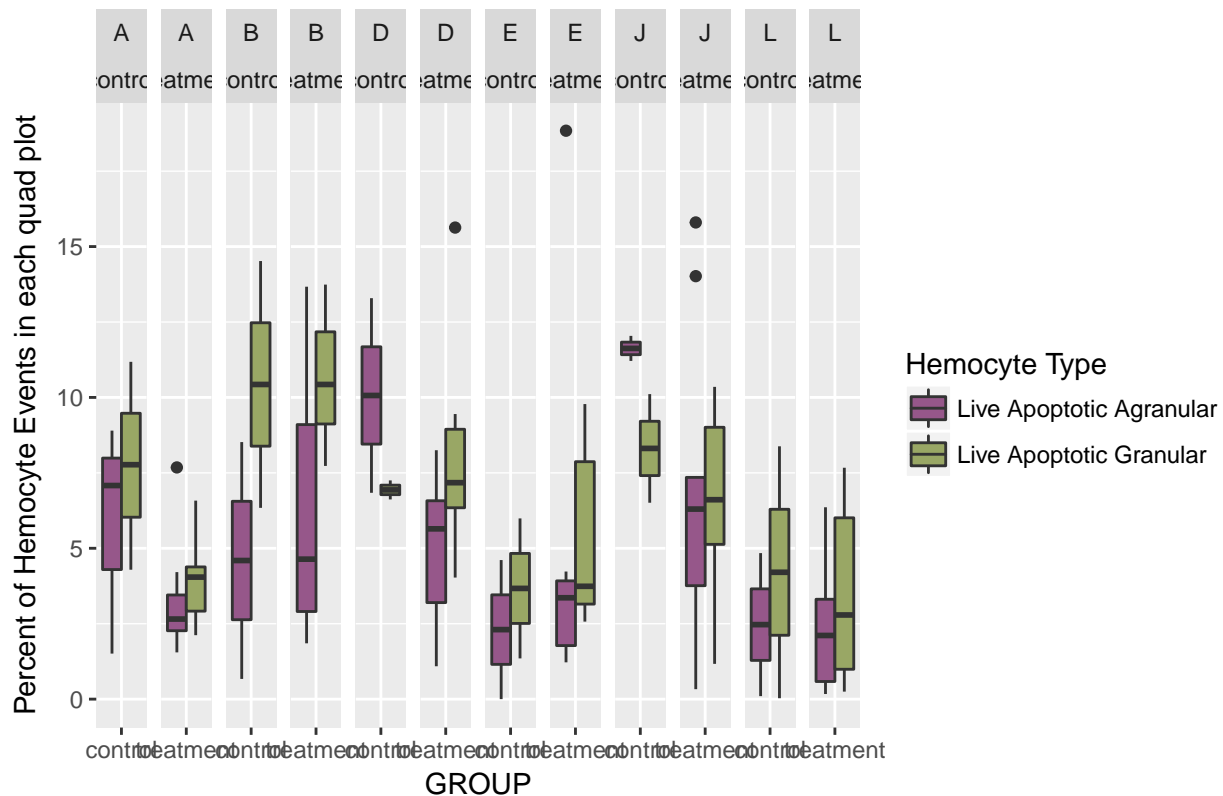
```

agranular_live_apoptotic_all <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED %>% filter(GATE=="Q")
granular_live_apoptotic_all <- APOP_PLOT4 GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED %>% filter(GATE=="Q")
APOP_Live_apoptotic_combined_all <- rbind(agranular_live_apoptotic_all, granular_live_apoptotic_all)

ggplot(APOP_Live_apoptotic_combined_all, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=GATE)) + facet_grid(

```

Percent of Granular and Agranular Live Apoptotic Hemocytes (low quality re



Two-Way ANOVA

```

APOP_Live_apoptotic_combined_all_aov <- lm(APOP_Live_apoptotic_combined_all$Arcsine ~ APOP_Live_apoptot
Anova(APOP_Live_apoptotic_combined_all_aov, type="II") #family and GATE significantly different

```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_Live_apoptotic_combined_all$Arcsine
```

```
##
```

```
## APOP_Live_apoptotic_combined_all$FAMILY 0.22292 5 6.6286 2.056e-05 ***
```

```
## APOP_Live_apoptotic_combined_all$GATE 0.03701 1 5.5025 0.02083 *
```

```
## Residuals
```

```
0.71967 107
```

```
## ---
```

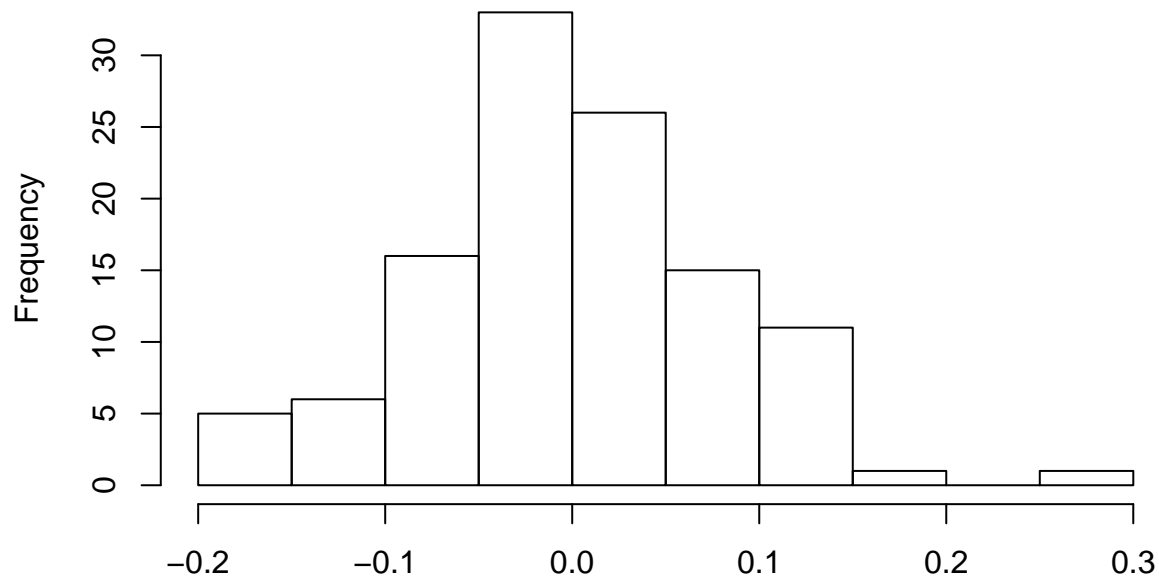
```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_Live_apoptotic_combined_all_aov)
```

```
##
```

```
## Call:
## lm(formula = APOP_Live_apoptotic_combined_all$Arcsine ~ APOP_Live_apoptotic_combined_all$FAMILY +
##     APOP_Live_apoptotic_combined_all$GATE, data = APOP_Live_apoptotic_combined_all)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.184993 -0.047310 -0.002528  0.048968  0.267684
##
## Coefficients:
##                                Estimate Std. Error t value
## (Intercept)                   0.187236   0.019098   9.804
## APOP_Live_apoptotic_combined_all$FAMILYB  0.074068   0.026065   2.842
## APOP_Live_apoptotic_combined_all$FAMILYD  0.056064   0.026946   2.081
## APOP_Live_apoptotic_combined_all$FAMILYE -0.005935   0.026065  -0.228
## APOP_Live_apoptotic_combined_all$FAMILYJ  0.055235   0.024727   2.234
## APOP_Live_apoptotic_combined_all$FAMILYL -0.055021   0.026065  -2.111
## APOP_Live_apoptotic_combined_all$GATEQ2_LR  0.036036   0.015362   2.346
##                                Pr(>|t|)
## (Intercept)                   < 2e-16 ***
## APOP_Live_apoptotic_combined_all$FAMILYB  0.00537 **
## APOP_Live_apoptotic_combined_all$FAMILYD  0.03986 *
## APOP_Live_apoptotic_combined_all$FAMILYE  0.82030
## APOP_Live_apoptotic_combined_all$FAMILYJ  0.02758 *
## APOP_Live_apoptotic_combined_all$FAMILYL  0.03711 *
## APOP_Live_apoptotic_combined_all$GATEQ2_LR 0.02083 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08201 on 107 degrees of freedom
## Multiple R-squared:  0.2653, Adjusted R-squared:  0.2241
## F-statistic: 6.441 on 6 and 107 DF, p-value: 8.071e-06
hist(residuals(APOP_Live_apoptotic_combined_all_aov))
```


Histogram of residuals(APOP_Live_apoptotic_combined_all_aov)



residuals(APOP_Live_apoptotic_combined_all_aov)

```
# Two-Way ANOVA with interaction
```

```
APOP_Live_apoptotic_combined_all_aov_interaction <- lm(Arcsine ~ FAMILY + GATE + FAMILY:GATE, data=APOP_Live_apoptotic_combined_all)
Anova(APOP_Live_apoptotic_combined_all_aov_interaction, type="II") #family and GATE are significantly different
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: Arcsine
```

	Sum Sq	Df	F value	Pr(>F)
FAMILY	0.22292	5	6.5765	2.416e-05 ***
GATE	0.03701	1	5.4592	0.02142 *
FAMILY:GATE	0.02820	5	0.8318	0.53002
Residuals	0.69148	102		

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_Live_apoptotic_combined_all_aov_interaction)
```

```
##
```

```
## Call:
```

```
## lm(formula = Arcsine ~ FAMILY + GATE + FAMILY:GATE, data = APOP_Live_apoptotic_combined_all)
```

```
##
```

```
## Residuals:
```

	Min	1Q	Median	3Q	Max
Residuals	-0.205554	-0.049804	-0.004193	0.050482	0.268398

```
##
```

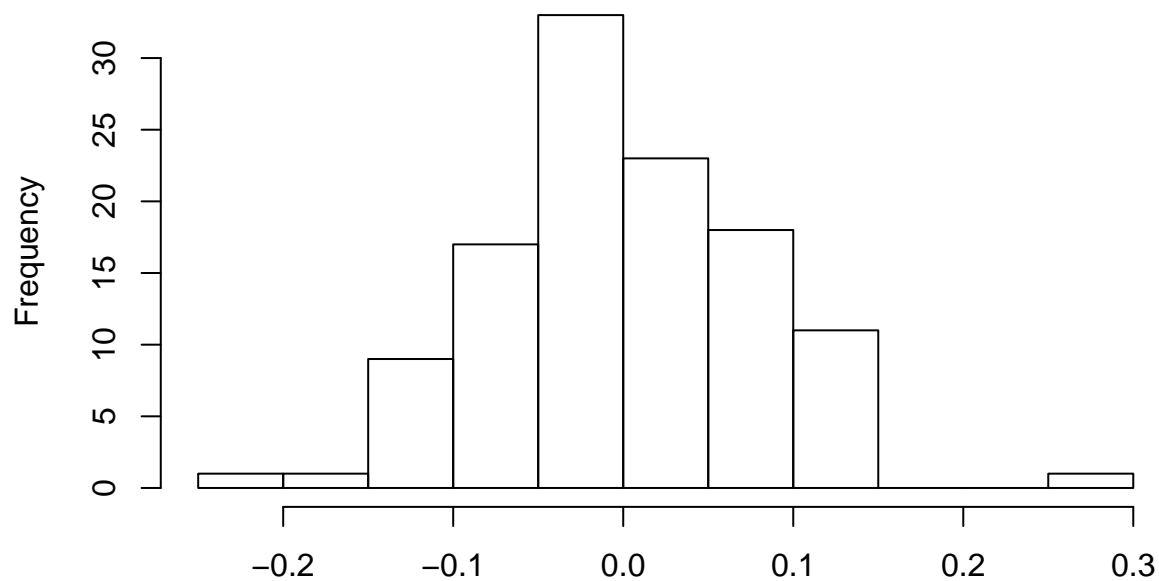
```
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.192227	0.024825	7.743	7.32e-12 ***
FAMILYB	0.037298	0.037007	1.008	0.3159
FAMILYD	0.049565	0.038258	1.296	0.1981

```
## FAMILYE          -0.011640    0.037007   -0.315    0.7538
## FAMILYJ           0.070804    0.035108    2.017    0.0464 *
## FAMILYL          -0.057407    0.037007   -1.551    0.1239
## GATEQ2_LR         0.026053    0.035108    0.742    0.4597
## FAMILYB:GATEQ2_LR 0.073542    0.052336    1.405    0.1630
## FAMILYD:GATEQ2_LR 0.012999    0.054105    0.240    0.8106
## FAMILYE:GATEQ2_LR 0.011410    0.052336    0.218    0.8279
## FAMILYJ:GATEQ2_LR -0.031139    0.049650   -0.627    0.5320
## FAMILYL:GATEQ2_LR 0.004773    0.052336    0.091    0.9275
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08234 on 102 degrees of freedom
## Multiple R-squared:  0.2941, Adjusted R-squared:  0.218
## F-statistic: 3.864 on 11 and 102 DF,  p-value: 0.0001137
```

```
hist(residuals(APOP_Live_apoptotic_combined_all_aov_interaction))
```

istogram of residuals(APOP_Live_apoptotic_combined_all_aov_intera



residuals(APOP_Live_apoptotic_combined_all_aov_interaction)

```
APOP_Live_apoptotic_combined_all_aov_interaction_leastsquare <- lsmeans(APOP_Live_apoptotic_combined_al
```

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

```
cld(APOP_Live_apoptotic_combined_all_aov_interaction_leastsquare, alpha=0.05, Letters=letters)
```

```
## FAMILY    lsmean      SE  df  lower.CL  upper.CL  .group
## L         0.1502328 0.01940677 102 0.1117396 0.1887261  a
## E         0.1993182 0.01940677 102 0.1608250 0.2378114  ab
## A         0.2052536 0.01755409 102 0.1704351 0.2400720  abc
## J         0.2604883 0.01755409 102 0.2256699 0.2953068  bc
## D         0.2613178 0.02058399 102 0.2204896 0.3021460  bc
## B         0.2793220 0.01940677 102 0.2408288 0.3178152  c
```

```
##
## Results are averaged over the levels of: GATE
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05
APOP_Live_apoptotic_combined_all_aov_interaction_leastsquare_gate <- lsmeans(APOP_Live_apoptotic_combined_all_aov_interaction_leastsquare_gate, alpha=0.05, Letters=letters) #th

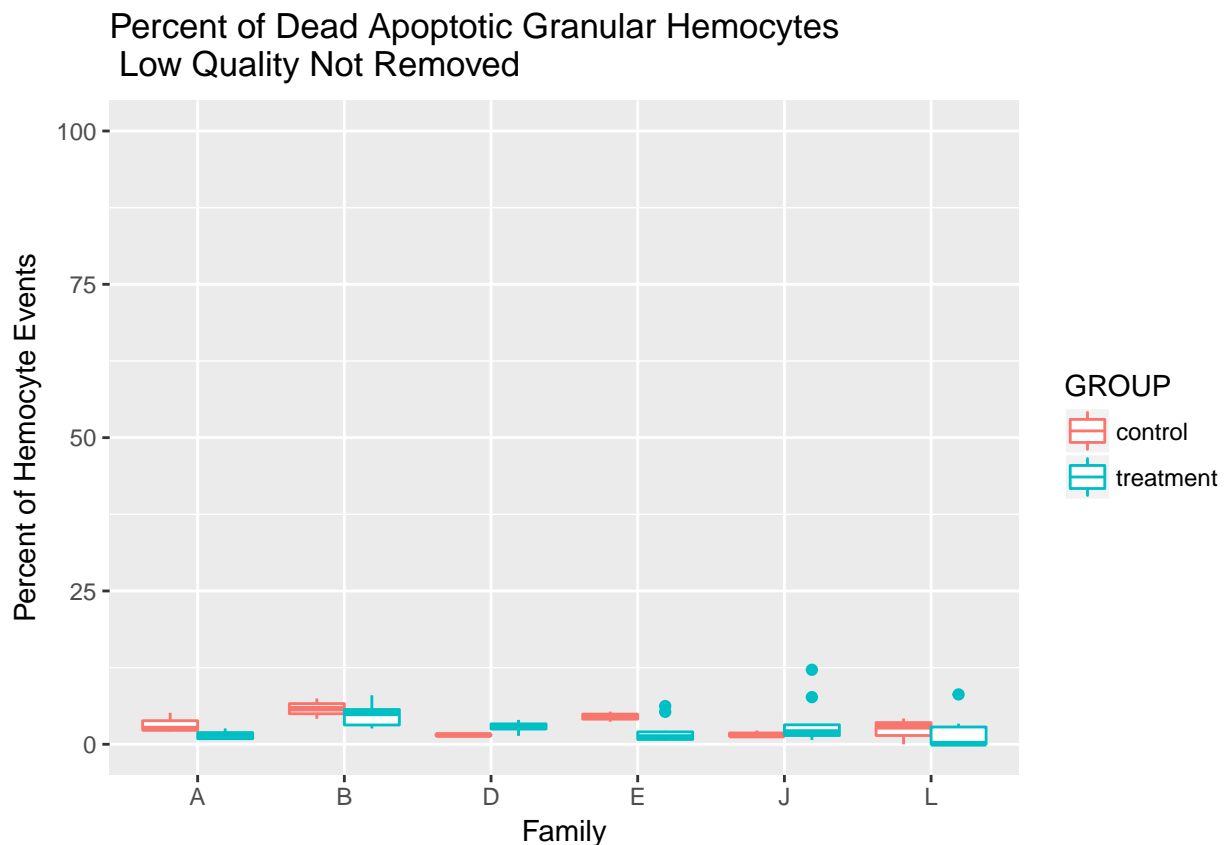
## NOTE: Results may be misleading due to involvement in interactions

## GATE      lsmean      SE df lower.CL upper.CL .group
## Q1_LR 0.2069967 0.01097943 102 0.1852190 0.2287743 a
## Q2_LR 0.2449809 0.01097943 102 0.2232033 0.2667586 b
##
## Results are averaged over the levels of: FAMILY
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

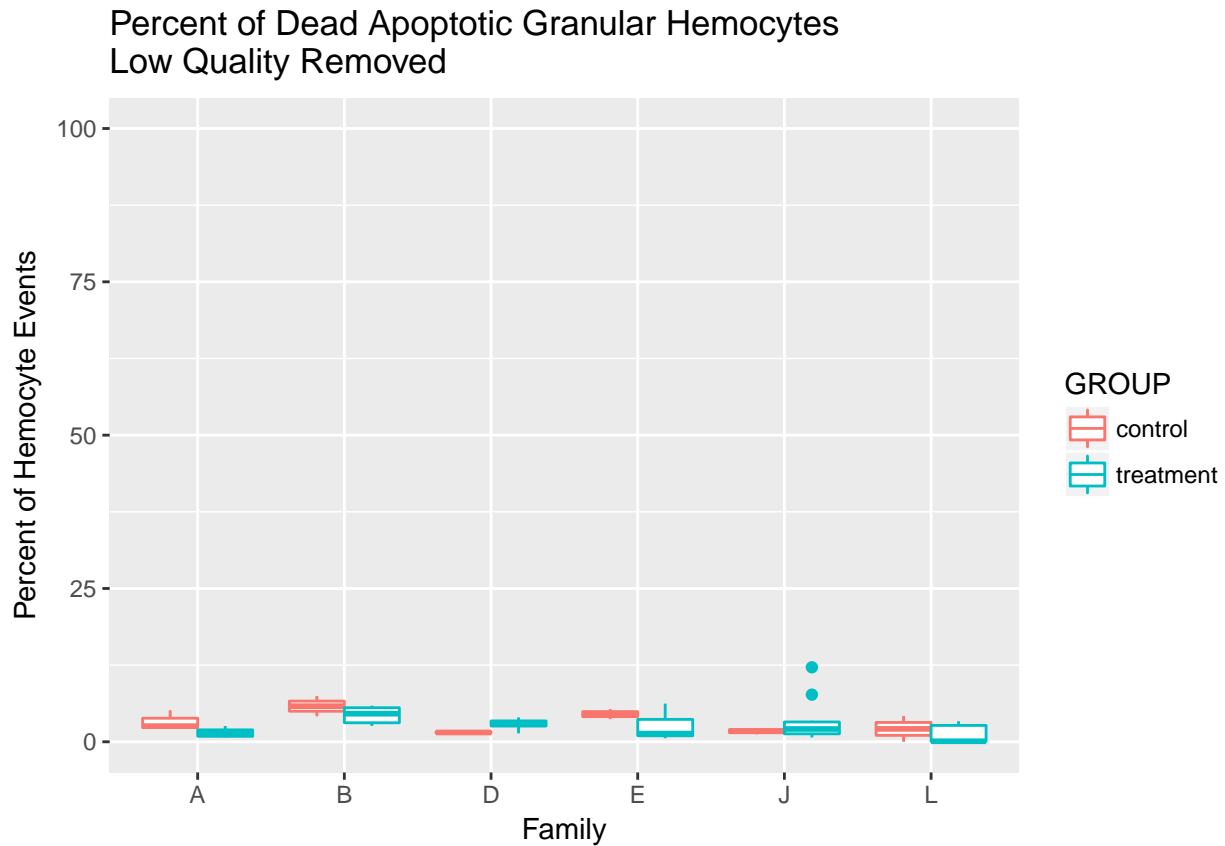
% DEAD apoptotic granular hemocytes (PLOT4, Q2-UR)

Percent DEAD apoptotic granular hemocytes (PLOT4, Q1-UR)

```
APOP_dead_apoptotic_granular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT4_GRANULAR_QUAD_PLOT, aes(x=FAMILY, y=PERCENT_DEAD, group=GROUP)) +
  geom_boxplot(aes(fill=GROUP, color=GROUP)) +
  facet_wrap(~FAMILY, scales='free') +
  theme_minimal()
APOP_dead_apoptotic_granular_BAD_NOT_REMOVED
```



```
APOP_dead_apoptotic_granular_BAD_REMOVED <- ggplot(data=APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, aes(
  xlab("Family") + ylab("Percent of Hemocyte Events") + ylim(0,100)
APOP_dead_apoptotic_granular_BAD_REMOVED
```



FAMILY A

```
APOP_PLOT_4_dead_granular_FAMILY_A_AOV <- aov(APOP_PLOT_4_granular_FAMILY_A$Q2.UR_Arcsine ~ APOP_PLOT_4.
summary(APOP_PLOT_4_dead_granular_FAMILY_A_AOV)
```

```
##                               Df    Sum Sq  Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A$GROUP  1 0.007312 0.007312   7.951 0.0182 *
## Residuals                          10 0.009197 0.000920
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_dead_granular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4.
summary(APOP_PLOT_4_dead_granular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##                               Df    Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP  1 0.007408 0.007408
## Residuals                                          9 0.009082 0.001009
##                                                    F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP  7.341  0.024 *
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FAMILY B

```
APOP_PLOT_4_dead_granular_FAMILY_B_AOV <- aov(APOP_PLOT_4_granular_FAMILY_B$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_B_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B$GROUP  1 0.000898 0.0008978   0.466  0.514
## Residuals                            8 0.015396 0.0019245
```

```
APOP_PLOT_4_dead_granular_FAMILY_B_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_B_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq   Mean Sq
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP  1 0.001757 0.001757
## Residuals                                         7 0.009888 0.001413
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP  1.244  0.302
## Residuals
```

FAMILY D

```
APOP_PLOT_4_dead_granular_FAMILY_D_AOV <- aov(APOP_PLOT_4_granular_FAMILY_D$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_D_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D$GROUP  1 0.003109 0.0031088   4.749 0.0657 .
## Residuals                            7 0.004583 0.0006547
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_dead_granular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_D_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq   Mean Sq
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP  1 0.003169 0.003169
## Residuals                                         6 0.004516 0.000753
```

```
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP  4.21  0.086 .
## Residuals
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FAMILY E

```
APOP_PLOT_4_dead_granular_FAMILY_E_AOV <- aov(APOP_PLOT_4_granular_FAMILY_E$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_E_AOV)
```

```
##                                Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E$GROUP  1 0.01057 0.010567   2.721  0.133
## Residuals                            9 0.03495 0.003883
```

```
APOP_PLOT_4_dead_granular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_E_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP  1 0.007159 0.007159
## Residuals                                         7 0.029893 0.004270
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP   1.676   0.236
## Residuals
```

FAMILY J

```
APOP_PLOT_4_dead_granular_FAMILY_J_AOV <- aov(APOP_PLOT_4_granular_FAMILY_J$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_J_AOV)
```

```
##                                Df    Sum Sq  Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J$GROUP  1 0.00443 0.004433   0.737   0.409
## Residuals                          11 0.06619 0.006017
```

```
APOP_PLOT_4_dead_granular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_J_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP  1 0.00319 0.003190
## Residuals                                         9 0.06474 0.007193
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP   0.443   0.522
## Residuals
```

FAMILY L

```
APOP_PLOT_4_dead_granular_FAMILY_L_AOV <- aov(APOP_PLOT_4_granular_FAMILY_L$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_L_AOV)
```

```
##                                Df    Sum Sq  Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_L$GROUP  1 0.00309 0.003087   0.286   0.604
## Residuals                          11 0.11886 0.010805
```

```
APOP_PLOT_4_dead_granular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT_4_
summary(APOP_PLOT_4_dead_granular_FAMILY_L_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq  Mean Sq
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP  1 0.00060 0.000596
## Residuals                                         7 0.06212 0.008875
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP   0.067   0.803
## Residuals
```

TWO WAY ANOVA

```
APOP_PLOT_4_dead_granular_TWO_WAY_AOV <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_Arcsine
Anova(APOP_PLOT_4_dead_granular_TWO_WAY_AOV, type="II")
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_Arcsine
```

```

##                               Sum Sq Df F value   Pr(>F)
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP  0.003833  1  0.8510 0.359898
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY 0.093481  5  4.1511 0.002605 **
## Residuals                            0.274741 61
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_4_dead_granular_TWO_WAY_AOV)

##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UR_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP +
##     APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.111343 -0.045350 -0.005694  0.030688  0.199476
##
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)                   0.14890    0.02434   6.116
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUPtreatment -0.01813    0.01966  -0.923
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYB         0.08768    0.02875   3.050
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYD         0.02320    0.02960   0.784
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYE         0.01332    0.02805   0.475
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYJ         0.02580    0.02687   0.960
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYL        -0.03755    0.02687  -1.398
##                               Pr(>|t|)
## (Intercept)                   7.45e-08 ***
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUPtreatment  0.35990
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYB         0.00339 **
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYD         0.43625
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYE         0.63642
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYJ         0.34065
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYL         0.16728
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06711 on 61 degrees of freedom
## Multiple R-squared:  0.2599, Adjusted R-squared:  0.1871
## F-statistic:  3.57 on 6 and 61 DF,  p-value: 0.004269

APOP_PLOT_4_dead_granular_TWO_WAY_AOV_BAD_REMOVED <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, type="II")

## Anova Table (Type II tests)
##
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine
##                               Sum Sq Df F value   Pr(>F)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.003039  1  0.7579
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.078908  5  3.9359
## Residuals                            0.200483 50
##                               Pr(>F)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.388144
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.004364 **

```

```

## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT4_dead_granular_TWO_WAY_AOV_BAD_REMOVED)

##
## Call:
## lm(formula = APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine ~
##     APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY,
##     data = APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.101670 -0.044786 -0.007722  0.030407  0.192469
##
## Coefficients:
##                                     Estimate
## (Intercept)                        0.14836
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.01745
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.08009
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.02241
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.02558
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.03266
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -0.04669
##                                     Std. Error
## (Intercept)                        0.02402
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment  0.02004
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.02848
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.02943
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.02848
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.02706
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         0.02848
##                                     t value Pr(>|t|)
## (Intercept)                        6.177 1.16e-07
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.871 0.38814
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         2.812 0.00701
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.762 0.44983
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.898 0.37347
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         1.207 0.23318
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -1.640 0.10739
##
## (Intercept)                        ***
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         **
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT4 GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06332 on 50 degrees of freedom
## Multiple R-squared:  0.2889, Adjusted R-squared:  0.2035
## F-statistic: 3.385 on 6 and 50 DF,  p-value: 0.007032

```



```

# INTERACTION TERM ADDED (using lm model)
APOP_PLOT_4_dead_granular_INTERACTION_aov <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine
Anova(APOP_PLOT_4_dead_granular_INTERACTION_aov, type="II") # family is significant

## Anova Table (Type II tests)
##
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.07
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.00
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.02
## Residuals 0.18
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 5
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 1
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 5
## Residuals 45
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 3.9
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.7
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 1.0
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.00
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.38
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP 0.41
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY **
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_4_dead_granular_INTERACTION_aov)

##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UR_Arcsine ~
##     APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##     data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##     weights = NULL)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.103325 -0.035622 -0.002897  0.029526  0.181270
##
## Coefficients:
##
## (Intercept)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ

```



```
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtre
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtre
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtre
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtre
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtre
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.06329 on 45 degrees of freedom
## Multiple R-squared:  0.3607, Adjusted R-squared:  0.2044
## F-statistic: 2.308 on 11 and 45 DF,  p-value: 0.0242

APOP_PLOT_4_dead_granular_INTERACTION_aov_least_squares <- lsmeans(APOP_PLOT_4_dead_granular_INTERACTION,
cld(APOP_PLOT_4_dead_granular_INTERACTION_aov_least_squares, alpha=0.05, Letters=letters) #each is signi.

## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY      lsmean      SE df
## A              0.1197823 0.02237580 45
## B              0.1197823 0.02237580 45
## D              0.1489169 0.02142320 45
## E              0.1489169 0.02142320 45
## J              0.1489169 0.02142320 45
## L              0.1636006 0.01637741 45
##      lower.CL  upper.CL .group
## 0.07471509 0.1648494  a
## 0.07471509 0.1648494  a
## 0.10576838 0.1920654  a
## 0.10576838 0.1920654  a
## 0.10576838 0.1920654  a
## 0.13061477 0.1965864  a
##
## Results are averaged over the levels of: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05
```

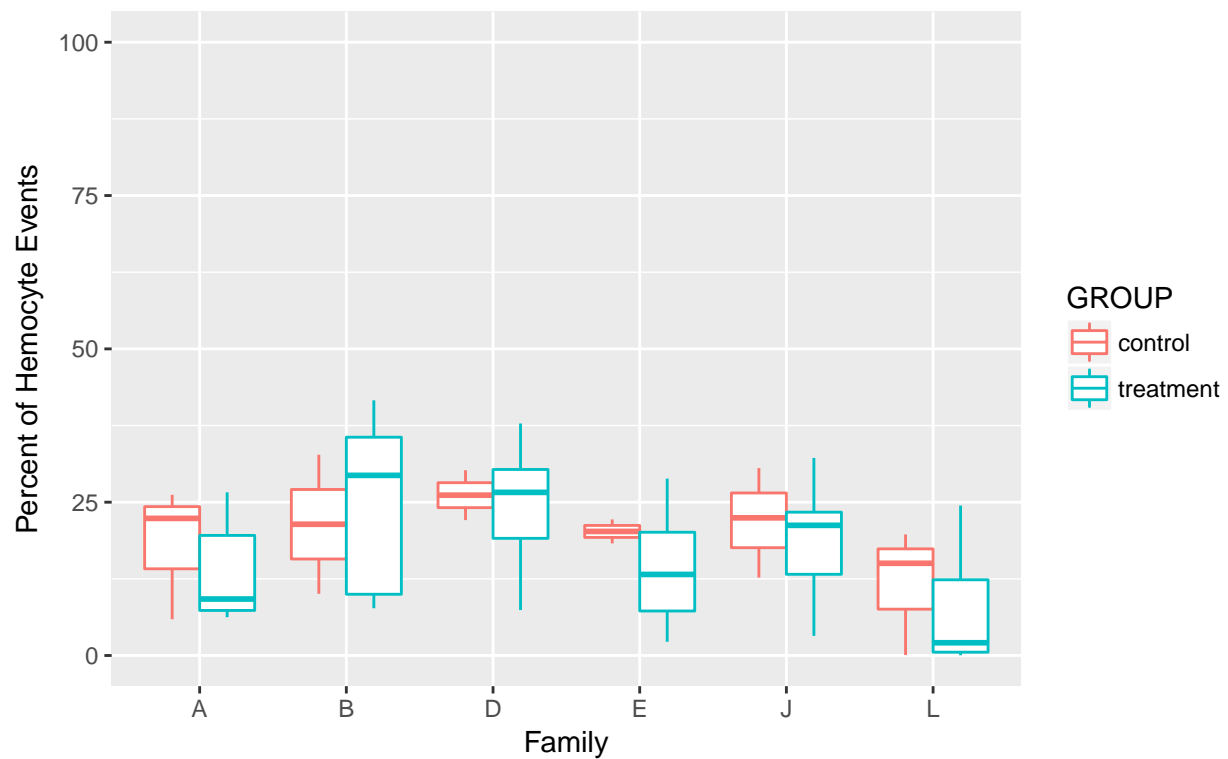
One Way ANOVA of Differences between Families

% DEAD apoptotic agranular hemocytes (PLOT 7, Q1-UR)

Percent DEAD apoptotic agranular hemocytes (PLOT 7, Q1-UR)

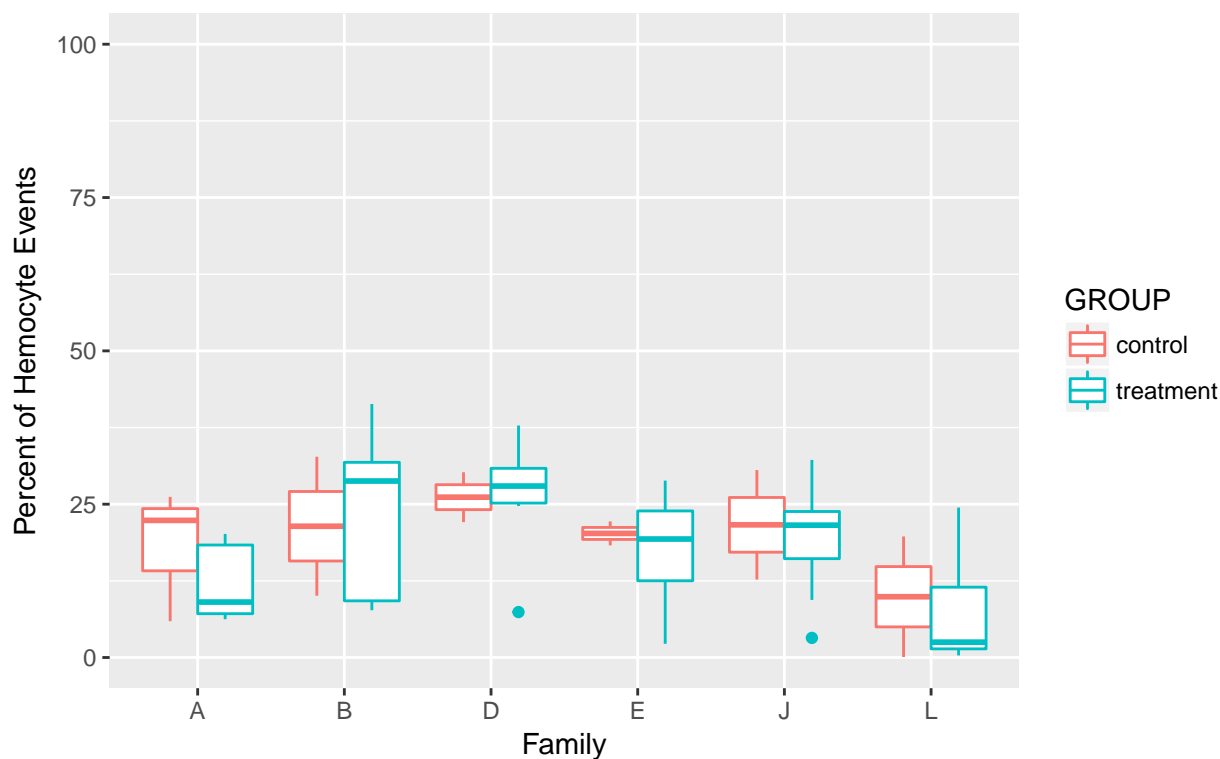
```
APOP_dead_apoptotic_Agranular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT7_AGRANULAR_QUAD_PLOT, aes(x=FAMILY))
APOP_dead_apoptotic_Agranular_BAD_NOT_REMOVED
```

Percent of Dead Apoptotic Agranular Hemocytes Low Quality Not Removed



```
APOP_dead_apoptotic_Agranular_BAD_REMOVED <- ggplot(data=APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED, aes(
  xlab("Family") + ylab("Percent of Hemocyte Events") + ylim(0,100)
APOP_dead_apoptotic_Agranular_BAD_REMOVED
```

Percent of Dead Apoptotic Agranular Hemocytes Low Quality Removed



FAMILY A

```
APOP_PLOT_7_dead_agranular_FAMILY_A_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_A$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_A$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_A_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A$GROUP  1 0.00773 0.007728   0.537  0.481
## Residuals                        10 0.14394 0.014394
```

```
APOP_PLOT_7_dead_agranular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_A_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP  1 0.01415 0.01415
## Residuals                        9 0.10933 0.01215
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP  1.165  0.309
## Residuals
```

FAMILY B

```
APOP_PLOT_7_dead_agranular_FAMILY_B_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_B$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_B$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_B_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
```

```
## APOP_PLOT_7_agranular_FAMILY_B$GROUP 1 0.00277 0.00277 0.083 0.781
## Residuals 8 0.26811 0.03351
```

```
APOP_PLOT_7_dead_agranular_FAMILY_B_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_B_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP 1 0.0003 0.00030 0.009
## Residuals 7 0.2253 0.03219
## Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP 0.925
## Residuals
```

FAMILY D

```
APOP_PLOT_7_dead_agranular_FAMILY_D_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_D$Q1.UR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_D$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_D_AOV)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D$GROUP 1 0.00134 0.001343 0.084 0.781
## Residuals 7 0.11229 0.016042
```

```
APOP_PLOT_7_dead_agranular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_D_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP 1 0.00009 0.00009 0.000 0.983
## Residuals 6 0.09264 0.01544
## F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP 0.006 0.942
## Residuals
```

FAMILY E

```
APOP_PLOT_7_dead_agranular_FAMILY_E_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_E$Q1.UR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_E$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_E_AOV)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E$GROUP 1 0.01271 0.01271 0.666 0.436
## Residuals 9 0.17185 0.01910
```

```
APOP_PLOT_7_dead_agranular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_dead_agranular_FAMILY_E_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP 1 0.00386 0.003857 0.000 0.983
## Residuals 7 0.12383 0.017691
## F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP 0.218 0.655
## Residuals
```

FAMILY J

```
APOP_PLOT_7_dead_agranular_FAMILY_J_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_J$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_J_AOV)
summary(APOP_PLOT_7_dead_agranular_FAMILY_J_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J$GROUP  1 0.00501 0.005006   0.343   0.57
## Residuals                          11 0.16033 0.014575
```

```
APOP_PLOT_7_dead_agranular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_J_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_dead_agranular_FAMILY_J_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  1 0.00166 0.001664
## Residuals                                          9 0.15357 0.017063
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  0.098  0.762
## Residuals
```

FAMILY L

```
APOP_PLOT_7_dead_agranular_FAMILY_L_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_L$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_L_AOV)
summary(APOP_PLOT_7_dead_agranular_FAMILY_L_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L$GROUP  1 0.0127 0.01266   0.337   0.573
## Residuals                          11 0.4128 0.03753
```

```
APOP_PLOT_7_dead_agranular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT_7_dead_agranular_FAMILY_L_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_dead_agranular_FAMILY_L_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  1 0.00008 0.00008
## Residuals                                          7 0.26287 0.03755
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  0.002  0.965
## Residuals
```

TWO WAY ANOVA

```
APOP_PLOT_7_dead_agranular_TWO_WAY_AOV <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY)
Anova(APOP_PLOT_7_dead_agranular_TWO_WAY_AOV, type="II")
```

```
## Anova Table (Type II tests)
##
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_Arcsine
##                               Sum Sq Df F value    Pr(>F)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP  0.02442  1  1.1575 0.2862202
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY  0.58557  5  5.5502 0.0002815 ***
## Residuals                          1.28717 61
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_PLOT7_dead_agranular_TWO_WAY_AOV)
```

```
##
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UR_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP +
##     APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT7_AGRANULAR_QUAD_PLOT)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.25505 -0.11640  0.03650  0.09035  0.28911
##
## Coefficients:
##                      Estimate Std. Error t value
## (Intercept)           0.41560    0.05269   7.887
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment -0.04577    0.04255  -1.076
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB         0.12037    0.06223   1.934
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD         0.13270    0.06407   2.071
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE         0.01588    0.06071   0.262
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ         0.06508    0.05816   1.119
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL        -0.14171    0.05816  -2.437
##                      Pr(>|t|)
## (Intercept)          6.88e-11 ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment  0.2862
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB         0.0577 .
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD         0.0426 *
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE         0.7946
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ         0.2675
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL         0.0178 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1453 on 61 degrees of freedom
## Multiple R-squared:  0.3203, Adjusted R-squared:  0.2534
## F-statistic: 4.791 on 6 and 61 DF,  p-value: 0.0004615
```

```
APOP_PLOT7_dead_agranular_TWO_WAY_AOV_BAD_REMOVED <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY, data = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED)
Anova(APOP_PLOT7_dead_agranular_TWO_WAY_AOV_BAD_REMOVED, type="II")
```

```
## Anova Table (Type II tests)
##
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine
##                      Sum Sq Df F value
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.00939  1  0.4801
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY  0.45959  5  4.6976
## Residuals                                0.97835 50
##                      Pr(>F)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.491583
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY 0.001358 **
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(APOP_PLOT7_dead_agranular_TWO_WAY_AOV_BAD_REMOVED)
```

```
##
```



```
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine ~
##      APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAM
##      data = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.27036 -0.10280  0.03097  0.10358  0.28523
##
## Coefficients:
##                                     Estimate
## (Intercept)                        0.38896
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.03067
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.11182
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.16378
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.06231
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.08517
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -0.12629
##                                     Std. Error
## (Intercept)                        0.05306
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment  0.04427
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         0.06291
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.06501
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.06291
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.05978
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         0.06291
##                                     t value Pr(>|t|)
## (Intercept)                        7.331 1.83e-09
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.693  0.4916
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         1.777  0.0816
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         2.519  0.0150
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.990  0.3268
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         1.425  0.1604
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        -2.007  0.0501
##
## (Intercept)                        ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB         .
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         *
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1399 on 50 degrees of freedom
## Multiple R-squared:  0.3236, Adjusted R-squared:  0.2424
## F-statistic: 3.986 on 6 and 50 DF,  p-value: 0.002455
##
## # INTERACTION TERM ADDED
APOP_PLOT7_dead_agranular_INTERACTION_aov <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine ~
Anova(APOP_PLOT7_dead_agranular_INTERACTION_aov, type="II") #family is significant

## Anova Table (Type II tests)
##
```

```

## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine
##
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_7_dead_agranular_INTERACTION_aov)

##
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UR_Arcsine ~
##      APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##      data = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY * APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##      weights = NULL)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.26611 -0.09201  0.03120  0.09928  0.27999
##
## Coefficients:
## (Intercept)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment

```



```
##
## Residual standard error: 0.1466 on 45 degrees of freedom
## Multiple R-squared: 0.331, Adjusted R-squared: 0.1675
## F-statistic: 2.024 on 11 and 45 DF, p-value: 0.04819

APOP_PLOT_7_dead_agranular_INTERACTION_aov_leastquares <- lsmeans(APOP_PLOT_7_dead_agranular_INTERACTION_aov_leastquares, alpha=0.05, Letters=letters)
cld(APOP_PLOT_7_dead_agranular_INTERACTION_aov_leastquares, alpha=0.05, Letters=letters)

## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY    lsmean      SE df
## A              0.3446900 0.05184378 45
## B              0.3446900 0.05184378 45
## D              0.3849555 0.04963664 45
## E              0.3849555 0.04963664 45
## J              0.3849555 0.04963664 45
## L              0.4123633 0.03794576 45
## lower.CL upper.CL .group
## 0.2402713 0.4491088 a
## 0.2402713 0.4491088 a
## 0.2849822 0.4849289 a
## 0.2849822 0.4849289 a
## 0.2849822 0.4849289 a
## 0.3359366 0.4887900 a
##
## Results are averaged over the levels of: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05
#each family is significantly different
```

One Way ANOVA of Differences between Families

```
APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED_CHALLENGE
APOP_PLOT_7_dead_agranular_oneway_aov <- aov(APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE)
summary(APOP_PLOT_7_dead_agranular_oneway_aov)

##                                     Df
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  5
## Residuals                                                             38
##                                     Sum Sq
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  0.370
## Residuals                                                             0.754
##                                     Mean Sq
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  0.07401
## Residuals                                                             0.01984
##                                     F value
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY    3.73
## Residuals
##                                     Pr(>F)
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  0.00762
## Residuals
##
## APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY **
## Residuals
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

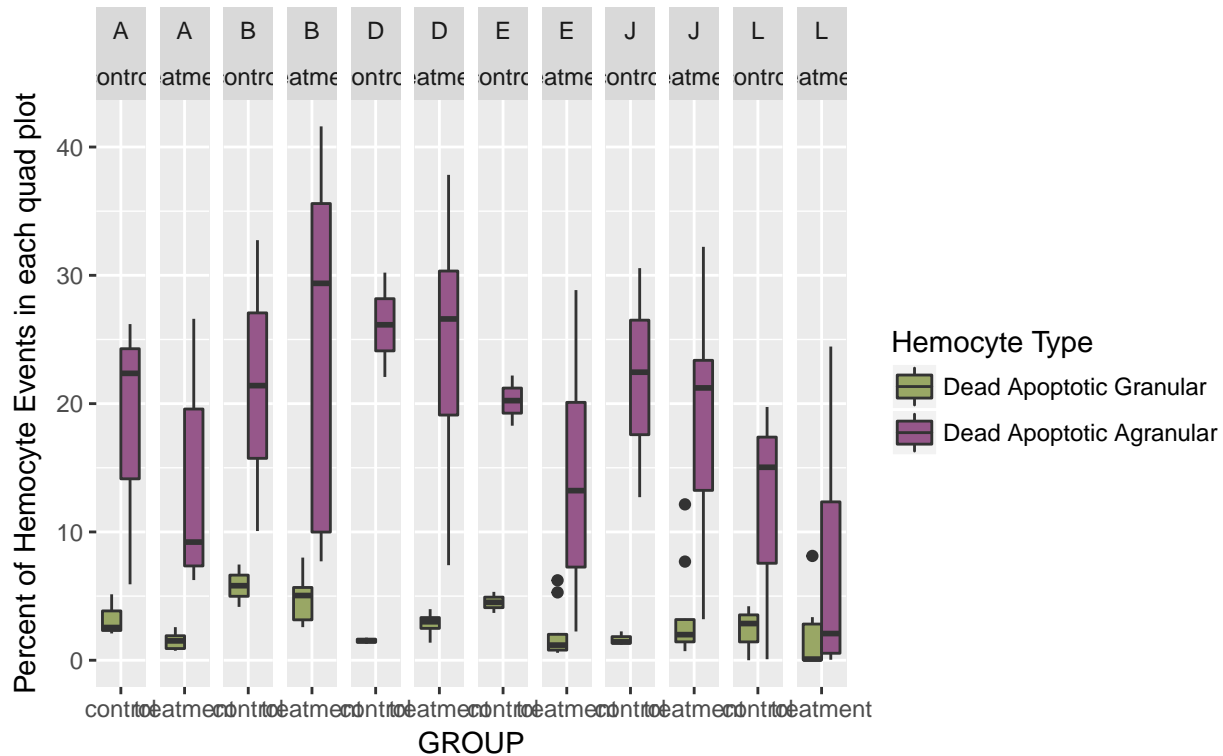
TukeyHSD(APOP_PLOT_7_dead_agranular_oneway_aov)

##    Tukey multiple comparisons of means
##      95% family-wise confidence level
##
## Fit: aov(formula = APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$Q1.UR_Arcsine ~ APOP_P
##
## $`APOP_PLOT_7_dead_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY`
##           diff           lwr           upr           p adj
## B-A  0.13534652 -0.08336146  0.354054503 0.4435284
## D-A  0.18310263 -0.04511880  0.411324054 0.1795580
## E-A  0.07165620 -0.14705178  0.290364176 0.9205755
## J-A  0.09855086 -0.10678803  0.303889762 0.7030758
## L-A -0.10745627 -0.32616425  0.111251712 0.6823533
## D-B  0.04775611 -0.18734791  0.282860121 0.9897027
## E-B -0.06369033 -0.28957096  0.162190304 0.9567138
## J-B -0.03679566 -0.24975796  0.176166642 0.9951202
## L-B -0.24280279 -0.46868342 -0.016922160 0.0288820
## E-D -0.11144643 -0.34655045  0.123657582 0.7136913
## J-D -0.08455176 -0.30727307  0.138169541 0.8619690
## L-D -0.29055890 -0.52566291 -0.055454883 0.0081052
## J-E  0.02689467 -0.18606763  0.239856969 0.9989006
## L-E -0.17911246 -0.40499310  0.046768166 0.1893945
## L-J -0.20600713 -0.41896943  0.006955169 0.0628821
```

Percent Dead Apoptotic Granular and Agranular Hemocytes

```
dead_apoptotic_granular <- APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED %>% filter(GATE=="Q2_UR")
dead_apoptotic_agranular <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED %>% filter(GATE=="Q1_UR")
combined_dead_apoptotic_agranular_granular <- rbind(dead_apoptotic_granular, dead_apoptotic_agranular)
ggplot(combined_dead_apoptotic_agranular_granular, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=GATE)) +
  geom_bar() +
  ylab("Percent of Hemocyte Events in each quad plot") + scale_fill_manual(name="Hemocyte Type", labels=
```

Percent of Granular and Agranular Dead Apoptotic Hemocytes in Challenged Oysters (low quality removed)



```
# Two-Way ANOVA
```

```
combined_dead_apoptotic_agranular_granular_aov <- lm(combined_dead_apoptotic_agranular_granular$Arcsine ~
Anova(combined_dead_apoptotic_agranular_granular_aov, type="II")
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: combined_dead_apoptotic_agranular_granular$Arcsine
```

```
##
```

	Sum Sq	Df	F value
combined_dead_apoptotic_agranular_granular\$FAMILY	0.53712	5	8.0202
combined_dead_apoptotic_agranular_granular\$GATE	2.16712	1	161.7977
Residuals	1.72783	129	

```
##
```

```
## Pr(>F)
```

```
## combined_dead_apoptotic_agranular_granular$FAMILY 1.303e-06 ***
```

```
## combined_dead_apoptotic_agranular_granular$GATE < 2.2e-16 ***
```

```
## Residuals
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(combined_dead_apoptotic_agranular_granular_aov)
```

```
##
```

```
## Call:
```

```
## lm(formula = combined_dead_apoptotic_agranular_granular$Arcsine ~
```

```
## combined_dead_apoptotic_agranular_granular$FAMILY + combined_dead_apoptotic_agranular_granular$GATE,
```

```
## data = combined_dead_apoptotic_agranular_granular)
```

```
##
```

```
## Residuals:
```

```
##
```

Min	1Q	Median	3Q	Max

```
## -0.27427 -0.06356 -0.01033 0.08266 0.24734
##
## Coefficients:
##
## Estimate Std. Error
## (Intercept) 0.13205 0.02562
## combined_dead_apoptotic_agranular_granular$FAMILYB 0.10243 0.03504
## combined_dead_apoptotic_agranular_granular$FAMILYD 0.07706 0.03609
## combined_dead_apoptotic_agranular_granular$FAMILYE 0.01242 0.03416
## combined_dead_apoptotic_agranular_granular$FAMILYJ 0.04483 0.03276
## combined_dead_apoptotic_agranular_granular$FAMILYL -0.09024 0.03276
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR 0.25247 0.01985
##
## t value Pr(>|t|)
## (Intercept) 5.153 9.35e-07 ***
## combined_dead_apoptotic_agranular_granular$FAMILYB 2.923 0.00409 **
## combined_dead_apoptotic_agranular_granular$FAMILYD 2.135 0.03461 *
## combined_dead_apoptotic_agranular_granular$FAMILYE 0.364 0.71672
## combined_dead_apoptotic_agranular_granular$FAMILYJ 1.368 0.17357
## combined_dead_apoptotic_agranular_granular$FAMILYL -2.755 0.00672 **
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR 12.720 < 2e-16 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1157 on 129 degrees of freedom
## Multiple R-squared: 0.6102, Adjusted R-squared: 0.592
## F-statistic: 33.65 on 6 and 129 DF, p-value: < 2.2e-16

#Two-Way ANOVA plus an interaction
combined_dead_apoptotic_agranular_granular_aov_interaction <- lm(combined_dead_apoptotic_agranular_granular_aov_interaction <- lm(combined_dead_apoptotic_agranular_granular_aov_interaction, type="II") #Gate and family are signi.

## Anova Table (Type II tests)
##
## Response: combined_dead_apoptotic_agranular_granular$Arcsine
##
## combined_dead_apoptotic_agranular_granular$FAMILY 0.1
## combined_dead_apoptotic_agranular_granular$GATE 2.
## combined_dead_apoptotic_agranular_granular$FAMILY:combined_dead_apoptotic_agranular_granular$GATE 0.
## Residuals 1.
##
## combined_dead_apoptotic_agranular_granular$FAMILY 5
## combined_dead_apoptotic_agranular_granular$GATE 12
## combined_dead_apoptotic_agranular_granular$FAMILY:combined_dead_apoptotic_agranular_granular$GATE 12
## Residuals 12
##
## combined_dead_apoptotic_agranular_granular$FAMILY 8
## combined_dead_apoptotic_agranular_granular$GATE 16
## combined_dead_apoptotic_agranular_granular$FAMILY:combined_dead_apoptotic_agranular_granular$GATE 16
## Residuals 16
##
## combined_dead_apoptotic_agranular_granular$FAMILY 7.
## combined_dead_apoptotic_agranular_granular$GATE <
## combined_dead_apoptotic_agranular_granular$FAMILY:combined_dead_apoptotic_agranular_granular$GATE 0
## Residuals
##
## combined_dead_apoptotic_agranular_granular$FAMILY ***
```

```

## combined_dead_apoptotic_agranular_granular$GATE
## combined_dead_apoptotic_agranular_granular$FAMILY:combined_dead_apoptotic_agranular_granular$GATE .
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(combined_dead_apoptotic_agranular_granular_aov_interaction)

##
## Call:
## lm(formula = combined_dead_apoptotic_agranular_granular$Arcsine ~
##     combined_dead_apoptotic_agranular_granular$FAMILY + combined_dead_apoptotic_agranular_granular$GATE,
##     data = combined_dead_apoptotic_agranular_granular)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.265614 -0.067390  0.000297  0.073355  0.278547
##
## Coefficients:
##
## (Intercept)
## combined_dead_apoptotic_agranular_granular$FAMILYB
## combined_dead_apoptotic_agranular_granular$FAMILYD
## combined_dead_apoptotic_agranular_granular$FAMILYE
## combined_dead_apoptotic_agranular_granular$FAMILYJ
## combined_dead_apoptotic_agranular_granular$FAMILYL
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYB:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYD:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYE:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYJ:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYL:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
##
## (Intercept)
## combined_dead_apoptotic_agranular_granular$FAMILYB
## combined_dead_apoptotic_agranular_granular$FAMILYD
## combined_dead_apoptotic_agranular_granular$FAMILYE
## combined_dead_apoptotic_agranular_granular$FAMILYJ
## combined_dead_apoptotic_agranular_granular$FAMILYL
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYB:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYD:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYE:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYJ:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYL:combined_dead_apoptotic_agranular_granular$GATEQ1_UR
##
## (Intercept)
## combined_dead_apoptotic_agranular_granular$FAMILYB
## combined_dead_apoptotic_agranular_granular$FAMILYD
## combined_dead_apoptotic_agranular_granular$FAMILYE
## combined_dead_apoptotic_agranular_granular$FAMILYJ
## combined_dead_apoptotic_agranular_granular$FAMILYL
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYB:combined_dead_apoptotic_agranular_granular$GATEQ1_UR

```



```

## combined_dead_apoptotic_agranular_granular$FAMILYD:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYE:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYJ:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYL:combined_dead_apoptotic_agranular_granular$GATEQ1
##
## (Intercept)
## combined_dead_apoptotic_agranular_granular$FAMILYB
## combined_dead_apoptotic_agranular_granular$FAMILYD
## combined_dead_apoptotic_agranular_granular$FAMILYE
## combined_dead_apoptotic_agranular_granular$FAMILYJ
## combined_dead_apoptotic_agranular_granular$FAMILYL
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYB:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYD:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYE:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYJ:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYL:combined_dead_apoptotic_agranular_granular$GATEQ1
##
## (Intercept)
## combined_dead_apoptotic_agranular_granular$FAMILYB
## combined_dead_apoptotic_agranular_granular$FAMILYD
## combined_dead_apoptotic_agranular_granular$FAMILYE
## combined_dead_apoptotic_agranular_granular$FAMILYJ
## combined_dead_apoptotic_agranular_granular$FAMILYL
## combined_dead_apoptotic_agranular_granular$GATEQ1_UR
## combined_dead_apoptotic_agranular_granular$FAMILYB:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYD:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYE:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYJ:combined_dead_apoptotic_agranular_granular$GATEQ1
## combined_dead_apoptotic_agranular_granular$FAMILYL:combined_dead_apoptotic_agranular_granular$GATEQ1
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1132 on 124 degrees of freedom
## Multiple R-squared:  0.6412, Adjusted R-squared:  0.6094
## F-statistic: 20.15 on 11 and 124 DF,  p-value: < 2.2e-16

combined_dead_apoptotic_agranular_granular_aov_interaction_leastlsquares <- lsmeans(combined_dead_apoptotic_agranular_granular_aov_interaction_leastlsquares, alpha=0.05, Letters=letters)

## combined_dead_apoptotic_agranular_granular$FAMILY      lsmean      SE
## A                0.1352963 0.03269035
## B                0.1352963 0.03269035
## D                0.1352963 0.03269035
## E                0.1352963 0.03269035
## J                0.1352963 0.03269035
## L                0.1352963 0.03269035
## df  lower.CL upper.CL .group
## 124 0.07059292 0.1999996 a
## 124 0.07059292 0.1999996 a
## 124 0.07059292 0.1999996 a
## 124 0.07059292 0.1999996 a
## 124 0.07059292 0.1999996 a
## 124 0.07059292 0.1999996 a
##

```

```
## Results are averaged over the levels of: combined_dead_apoptotic_agranular_granular$GATE
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 6 estimates
## significance level used: alpha = 0.05

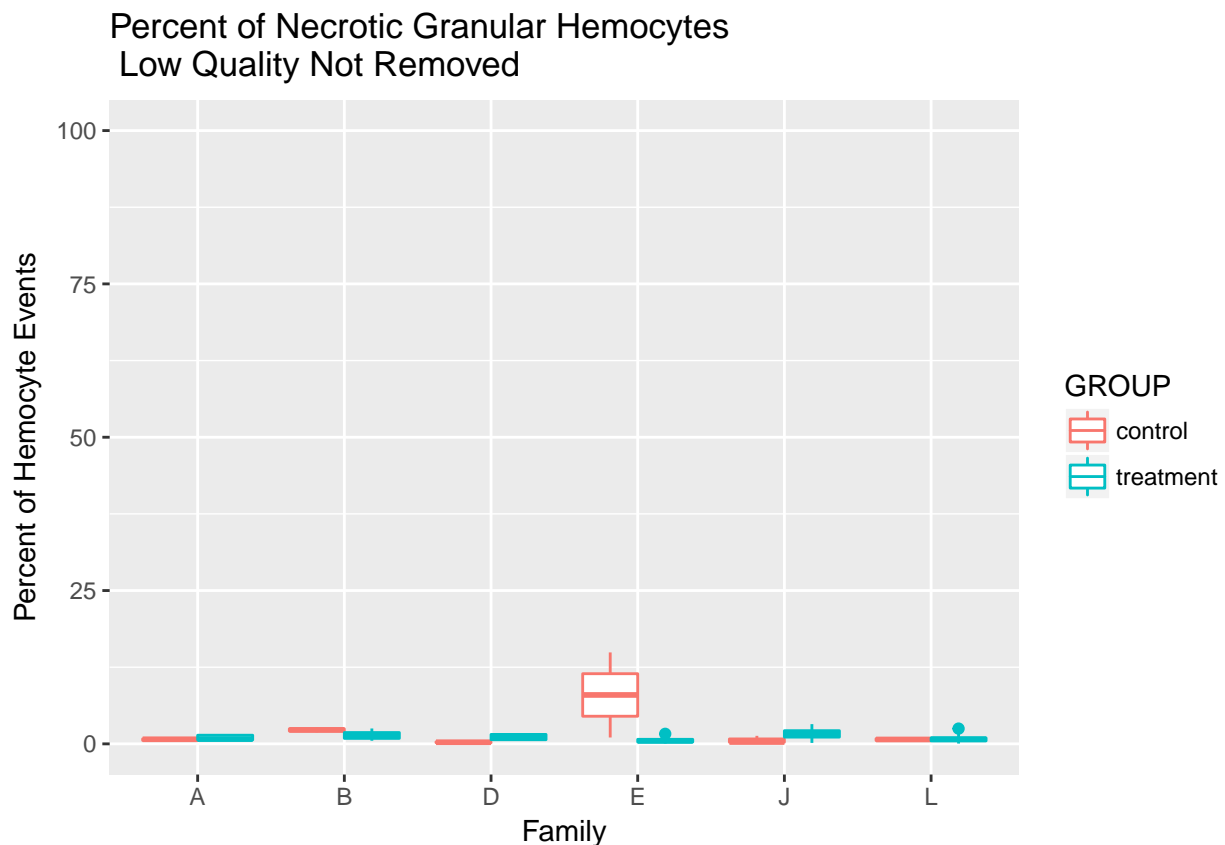
combined_dead_apoptotic_agranular_granular_aov_interaction_least_squares_gate <- lsmeans(combined_dead_apoptotic_agranular_granular_aov_interaction_least_squares_gate, alpha=0.05, Letters=)

## combined_dead_apoptotic_agranular_granular$GATE      lsmean      SE df
## Q2_UR                                                  0.1352963 0.03269035 124
## Q1_UR                                                  0.1352963 0.03269035 124
##      lower.CL upper.CL .group
## 0.07059292 0.1999996   a
## 0.07059292 0.1999996   a
##
## Results are averaged over the levels of: combined_dead_apoptotic_agranular_granular$FAMILY
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

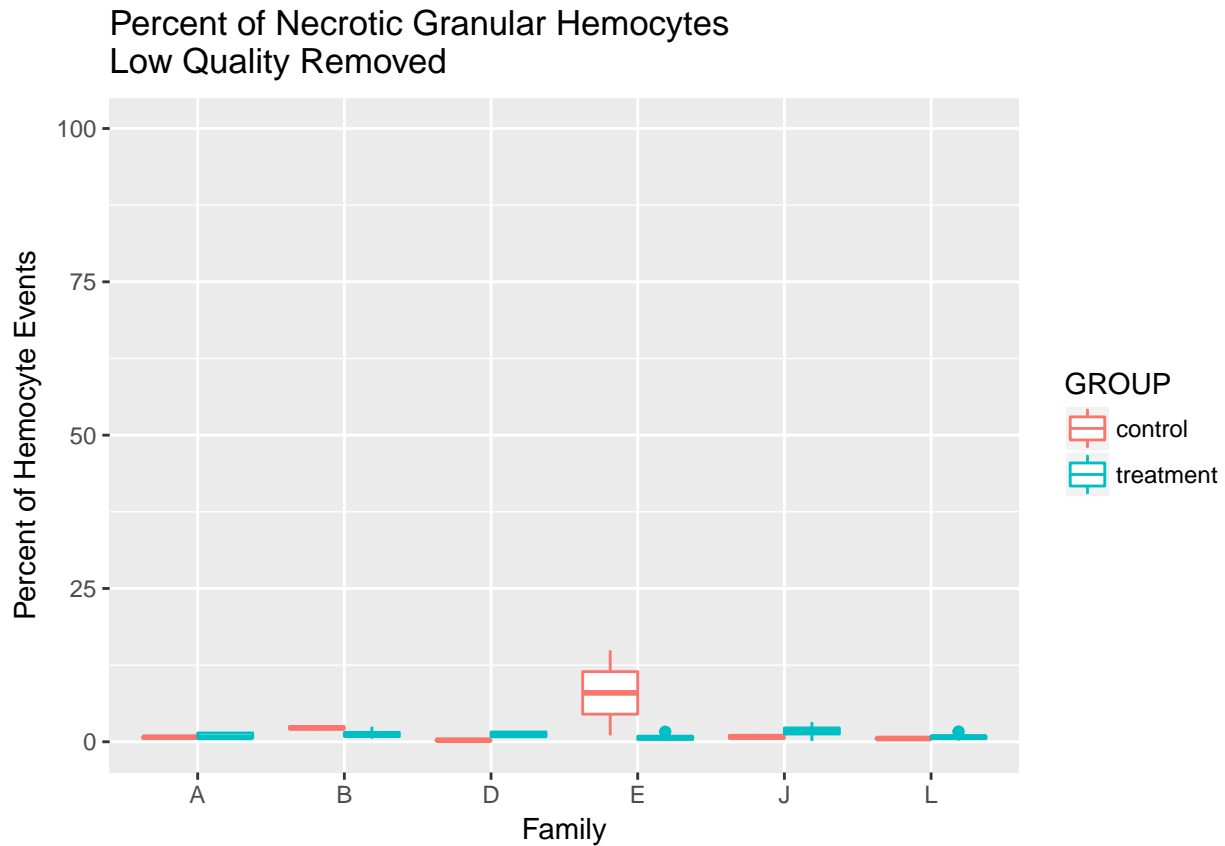
Percent necrotic granular hemocytes (PLOT 4, Q2-UL)

Percent Necrotic granular hemocytes (PLOT 4, Q2-UL)

```
APOP_necrotic_granular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT4_GRANULAR_QUAD_PLOT, aes(x=FAMILY, y=Q2_UR))
APOP_necrotic_granular_BAD_NOT_REMOVED
```



```
APOP_necrotic_granular_BAD_REMOVED <- ggplot(data=APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, aes(x=FAMILY, y=Percent of Hemocyte Events)) +
  xlab("Family") + ylab("Percent of Hemocyte Events") + ylim(0,100)
APOP_necrotic_granular_BAD_REMOVED
```



FAMILY A

```
APOP_PLOT_4_necrotic_granular_FAMILY_A_AOV <- aov(APOP_PLOT_4_granular_FAMILY_A$Q2.UL_Arcsine ~ APOP_PLOT_4_granular_FAMILY_A$GROUP)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_A_AOV)
```

```
##              Df    Sum Sq   Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A$GROUP  1 0.000559 0.0005586   1.454  0.256
## Residuals                        10 0.003840 0.0003840
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED ~ APOP_PLOT_4_granular_FAMILY_A$GROUP)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##              Df    Sum Sq   Mean Sq
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP  1 0.000549 0.0005488
## Residuals                        9 0.003840 0.0004266
##              F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_A_BAD_REMOVED$GROUP  1.286  0.286
## Residuals
```

FAMILY B

```
APOP_PLOT_4_necrotic_granular_FAMILY_B_AOV <- aov(APOP_PLOT_4_granular_FAMILY_B$Q2.UL_Arcsine ~ APOP_PL
summary(APOP_PLOT_4_necrotic_granular_FAMILY_B_AOV)
```

```
##                                Df    Sum Sq    Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B$GROUP  1 0.001919 0.0019191    2.124  0.183
## Residuals                            8 0.007227 0.0009034
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_B_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED
summary(APOP_PLOT_4_necrotic_granular_FAMILY_B_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq    Mean Sq
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP  1 0.002584 0.0025839
## Residuals                                         7 0.005127 0.0007325
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_B_BAD_REMOVED$GROUP    3.528  0.102
## Residuals
```

FAMILY D

```
APOP_PLOT_4_necrotic_granular_FAMILY_D_AOV <- aov(APOP_PLOT_4_granular_FAMILY_D$Q2.UL_Arcsine ~ APOP_PL
summary(APOP_PLOT_4_necrotic_granular_FAMILY_D_AOV)
```

```
##                                Df    Sum Sq    Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D$GROUP  1 0.004864 0.004864    9.258 0.0188 *
## Residuals                            7 0.003678 0.000525
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED
summary(APOP_PLOT_4_necrotic_granular_FAMILY_D_AOV_BAD_REMOVED)
```

```
##                                Df    Sum Sq    Mean Sq
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP  1 0.005411 0.005411
## Residuals                                         6 0.002958 0.000493
```

```
##                                F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_D_BAD_REMOVED$GROUP    10.98 0.0161 *
## Residuals
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FAMILY E

```
APOP_PLOT_4_necrotic_granular_FAMILY_E_AOV <- aov(APOP_PLOT_4_granular_FAMILY_E$Q2.UL_Arcsine ~ APOP_PL
summary(APOP_PLOT_4_necrotic_granular_FAMILY_E_AOV)
```

```
##                                Df    Sum Sq    Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E$GROUP  1 0.05108 0.05108    8.923 0.0153 *
## Residuals                            9 0.05153 0.00573
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED ~ APOP_PLOT_4_necrotic_granular_FAMILY_E_AOV_BAD_REMOVED)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_E_AOV_BAD_REMOVED)
```

```
##                               Df   Sum Sq Mean Sq F value
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP  1 0.04461 0.04461   6.396
## Residuals                                         7 0.04882 0.00697
##                               Pr(>F)
## APOP_PLOT_4_granular_FAMILY_E_BAD_REMOVED$GROUP 0.0393 *
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

FAMILY J

```
APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV <- aov(APOP_PLOT_4_granular_FAMILY_J$Q2.UL_Arcsine ~ APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV)
```

```
##                               Df   Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J$GROUP  1 0.005878 0.005878   4.14 0.0667 .
## Residuals                             11 0.015620 0.001420
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED ~ APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV_BAD_REMOVED)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_J_AOV_BAD_REMOVED)
```

```
##                               Df   Sum Sq Mean Sq
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP  1 0.002738 0.002738
## Residuals                                         9 0.014271 0.001586
##                               F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_J_BAD_REMOVED$GROUP  1.727 0.221
## Residuals
```

FAMILY L

```
APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV <- aov(APOP_PLOT_4_granular_FAMILY_L$Q2.UL_Arcsine ~ APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV)
```

```
##                               Df   Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_L$GROUP  1 0.000053 0.0000527   0.04 0.846
## Residuals                             11 0.014573 0.0013248
```

```
APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED ~ APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV_BAD_REMOVED)
summary(APOP_PLOT_4_necrotic_granular_FAMILY_L_AOV_BAD_REMOVED)
```

```
##                               Df   Sum Sq Mean Sq
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP  1 0.000274 0.0002743
## Residuals                                         7 0.004726 0.0006751
##                               F value Pr(>F)
## APOP_PLOT_4_granular_FAMILY_L_BAD_REMOVED$GROUP  0.406 0.544
## Residuals
```

TWO WAY ANOVA

```
APOP_PLOT_4_necrotic_granular_TWO_WAY_AOV <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP + APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT, type="II")
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_Arcsine
```

```
## Sum Sq Df F value Pr(>F)
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP 0.000768 1 0.2926 0.5905
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY 0.011326 5 0.8633 0.5110
```

```
## Residuals 0.160051 61
```

```
summary(APOP_PLOT_4_necrotic_granular_TWO_WAY_AOV) #nothing significant
```

```
##
```

```
## Call:
```

```
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT$Q2.UL_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUP +
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT)
```

```
##
```

```
## Residuals:
```

```
## Min 1Q Median 3Q Max
```

```
## -0.078765 -0.021768 -0.005298 0.020258 0.285060
```

```
##
```

```
## Coefficients:
```

```
## Estimate Std. Error t value
```

```
## (Intercept) 0.0990386 0.0185810 5.330
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUPtreatment -0.0081152 0.0150026 -0.541
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYB 0.0306175 0.0219452 1.395
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYD -0.0002206 0.0225910 -0.010
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYE 0.0123389 0.0214061 0.576
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYJ 0.0188651 0.0205076 0.920
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYL -0.0075145 0.0205076 -0.366
```

```
##
```

```
## Pr(>|t|) 1.51e-06 ***
```

```
## (Intercept) 0.591
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$GROUPtreatment 0.168
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYB 0.992
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYD 0.566
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYE 0.361
```

```
## APOP_PLOT4_GRANULAR_QUAD_PLOT$FAMILYJ 0.715
```

```
## ---
```

```
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
```

```
## Residual standard error: 0.05122 on 61 degrees of freedom
```

```
## Multiple R-squared: 0.06943, Adjusted R-squared: -0.0221
```

```
## F-statistic: 0.7585 on 6 and 61 DF, p-value: 0.6052
```

```
# INTERACTION TERM ADDED
```

```
APOP_PLOT_4_necrotic_granular_INTERACTION_aov <- lm(APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UL_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY, data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, type="II")
```

```
Anova(APOP_PLOT_4_necrotic_granular_INTERACTION_aov, type="II") #the interaction term is significant
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.UL_Arcsine
```

```

##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## Residuals
##
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP ***
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(APOP_PLOT_4_necrotic_granular_INTERACTION_aov)

##
## Call:
## lm(formula = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$Q2.Ul_Arcsine ~
##     APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY + APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP
##     APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP,
##     data = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED, weights = APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$W)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.147140 -0.016909  0.002601  0.018301  0.147140
##
## Coefficients:
## (Intercept)
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL:APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
##

```



```

## Residual standard error: 0.0421 on 45 degrees of freedom
## Multiple R-squared:  0.4621, Adjusted R-squared:  0.3307
## F-statistic: 3.515 on 11 and 45 DF,  p-value: 0.001325
#mean separations for the interaction effect with lsmeans
APOP_PLOT_4_necrotic_granular_INTERACTION_aov_leastquares <- lsmeans(APOP_PLOT_4_necrotic_granular_INTI
cld(APOP_PLOT_4_necrotic_granular_INTERACTION_aov_leastquares, alpha=0.05, Letters=letters) #groups ar

## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY
## D
## E
## J
## A
## B
## D
## E
## J
## L
## A
## B
## L
## APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP      lsmean      SE df
## treatment      0.08113521 0.02430419 45
## treatment      0.08113521 0.02430419 45
## treatment      0.08113521 0.02430419 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## control        0.09699448 0.01488322 45
## treatment      0.09699448 0.01488322 45
## treatment      0.09699448 0.01488322 45
## treatment      0.11011400 0.01591083 45
##      lower.CL upper.CL .group
## 0.03218405 0.1300864  a
## 0.03218405 0.1300864  a
## 0.03218405 0.1300864  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.06701814 0.1269708  a
## 0.07806795 0.1421601  a
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 12 estimates
## significance level used: alpha = 0.05

```

One Way ANOVA of Differences between Families

```
APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE <- APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED_CHALLENGE
APOP_PLOT_4_necrotic_granular_oneway_aov <- aov(APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE ~ APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED_CHALLENGE)
summary(APOP_PLOT_4_necrotic_granular_oneway_aov)
```

```
##                                     Df
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  5
## Residuals                                                                38
##                                     Sum Sq
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.01134
## Residuals                                                                0.03288
##                                     Mean Sq
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.0022681
## Residuals                                                                0.0008652
##                                     F value
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY  2.621
## Residuals
##                                     Pr(>F)
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.0393
## Residuals
##
## APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY *
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
TukeyHSD(APOP_PLOT_4_necrotic_granular_oneway_aov)
```

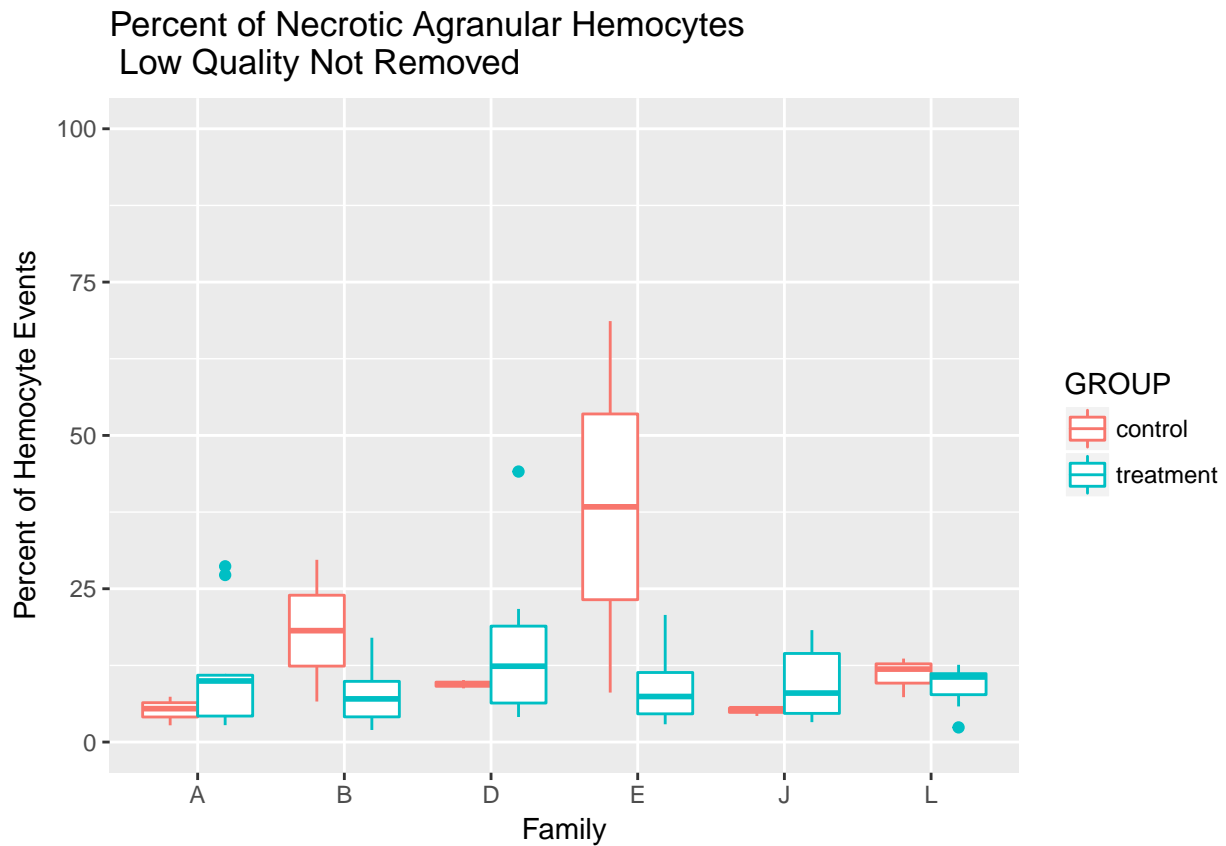
```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$Q2.UL_Arcsine ~ APOP_PLOT4_GRANULAR_QUAD_PLOT_BAD_REMOVED_CHALLENGE)
##
## $`APOP_PLOT_4_necrotic_granular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY`
##      diff      lwr      upr      p adj
## B-A  0.013119518 -0.032549852 0.058788887 0.9532274
## D-A  0.012079653 -0.035576261 0.059735567 0.9724599
## E-A -0.017039492 -0.062708862 0.028629877 0.8703332
## J-A  0.028663445 -0.014214268 0.071541158 0.3582521
## L-A -0.011640857 -0.057310226 0.034028513 0.9717891
## D-B -0.001039865 -0.050132962 0.048053233 0.9999998
## E-B -0.030159010 -0.077326132 0.017008112 0.4072058
## J-B  0.015543928 -0.028925661 0.060013517 0.8981528
## L-B -0.024760374 -0.071927496 0.022406748 0.6194987
## E-D -0.029119145 -0.078212242 0.019973952 0.4905291
## J-D  0.016583792 -0.029923617 0.063091202 0.8902355
## L-D -0.023720509 -0.072813607 0.025372588 0.6972283
## J-E  0.045702938  0.001233348 0.090172527 0.0409537
## L-E  0.005398636 -0.041768486 0.052565758 0.9993170
## L-J -0.040304302 -0.084773891 0.004165287 0.0947731
```

Percent necrotic agranular hemocytes (PLOT 7, Q1-UL)

Percent necrotic agranular hemocytes (PLOT 7, Q1-UL)

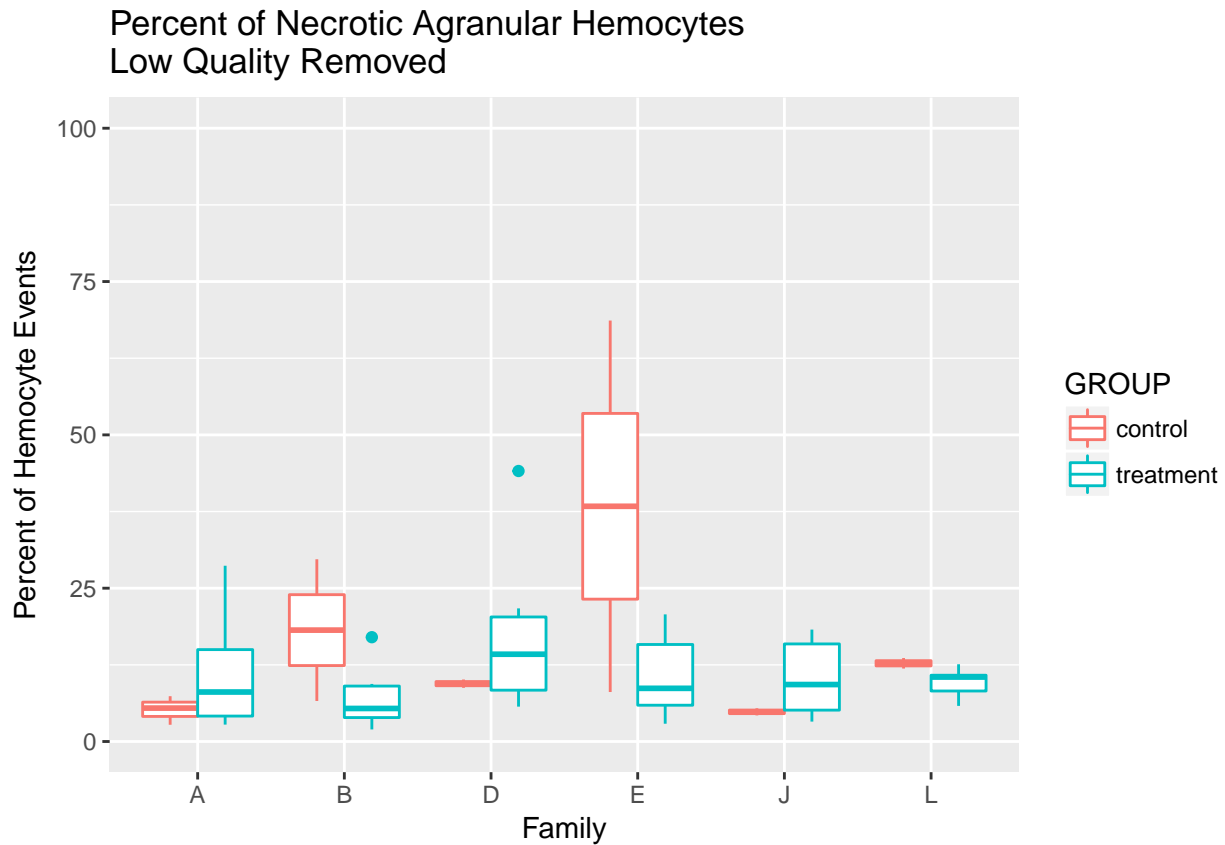
```
APOP_necrotic_Agranular_BAD_NOT_REMOVED <- ggplot(data=APOP_PLOT7_AGRANULAR_QUAD_PLOT, aes(x=FAMILY, y=
```

```
APOP_necrotic_Agranular_BAD_NOT_REMOVED
```



```
APOP_necrotic_Agranular_BAD_REMOVED <- ggplot(data=APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED, aes(x=FAMILY, y=
```

```
APOP_necrotic_Agranular_BAD_REMOVED
```



FAMILY A

```
APOP_PLOT_7_necrotic_agranular_FAMILY_A_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_A$Q1.UL_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_A$GROUP)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_A_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A$GROUP  1  0.02189  0.02189    1.255   0.289
## Residuals                        10  0.17438  0.01744
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_A_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$Q1.UL_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_A_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP  1  0.02129  0.02129
## Residuals                        9  0.17438  0.01937
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_A_BAD_REMOVED$GROUP  1.099   0.322
## Residuals
```

FAMILY B

```
APOP_PLOT_7_necrotic_agranular_FAMILY_B_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_B$Q1.UL_Arcsine ~ APOP_PLOT_7_agranular_FAMILY_B$GROUP)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_B_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
```

```
## APOP_PLOT_7_agranular_FAMILY_B$GROUP 1 0.0356 0.03560 2.572 0.147
## Residuals 8 0.1107 0.01384
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_B_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED ~ APOP_PLOT_7_necrotic_agranular_FAMILY_B_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_B_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP 1 0.03981 0.03981
## Residuals 7 0.10416 0.01488
## F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_B_BAD_REMOVED$GROUP 2.676 0.146
## Residuals
```

FAMILY D

```
APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_D$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D$GROUP 1 0.00833 0.008328 0.298 0.602
## Residuals 7 0.19539 0.027914
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED ~ APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_D_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP 1 0.01605 0.01605
## Residuals 6 0.15694 0.02616
## F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_D_BAD_REMOVED$GROUP 0.613 0.463
## Residuals
```

FAMILY E

```
APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_E$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV)
```

```
## Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E$GROUP 1 0.1769 0.17687 4.834 0.0555 .
## Residuals 9 0.3293 0.03659
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED ~ APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_E_AOV_BAD_REMOVED)
```

```
## Df Sum Sq Mean Sq F value
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP 1 0.1515 0.15148 3.326
## Residuals 7 0.3188 0.04554
## Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_E_BAD_REMOVED$GROUP 0.111
## Residuals
```

FAMILY J

```
APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_J$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J$GROUP  1 0.01263 0.012632   1.569  0.236
## Residuals                          11 0.08858 0.008053
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_J_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  1 0.01344 0.013441
## Residuals                                          9 0.07915 0.008795
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_J_BAD_REMOVED$GROUP  1.528  0.248
## Residuals
```

FAMILY L

```
APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV <- aov(APOP_PLOT_7_agranular_FAMILY_L$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV)
```

```
##                               Df Sum Sq Mean Sq F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L$GROUP  1 0.00215 0.002152   0.551  0.474
## Residuals                          11 0.04300 0.003909
```

```
APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV_BAD_REMOVED <- aov(APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$Q1.UL_Arcsine ~ APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV_BAD_REMOVED)
summary(APOP_PLOT_7_necrotic_agranular_FAMILY_L_AOV_BAD_REMOVED)
```

```
##                               Df Sum Sq Mean Sq
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  1 0.004293 0.004293
## Residuals                                          7 0.010608 0.001515
##                               F value Pr(>F)
## APOP_PLOT_7_agranular_FAMILY_L_BAD_REMOVED$GROUP  2.833  0.136
## Residuals
```

TWO WAY ANOVA

```
APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP + APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY)
Anova(APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV, type="II")
```

```
## Anova Table (Type II tests)
```

```
##
```

```
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_Arcsine
```

```
##                               Sum Sq Df F value Pr(>F)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP  0.00995  1  0.5107 0.4775
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY  0.06989  5  0.7172 0.6129
## Residuals                          1.18886 61
```

```
summary(APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV)
```

```
##
```

```
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT$Q1.UL_Arcsine ~ APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUP +
##     APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILY, data = APOP_PLOT7_AGRANULAR_QUAD_PLOT)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.18680 -0.08516 -0.03674  0.04425  0.58927
##
## Coefficients:
##              Estimate Std. Error
## (Intercept)      0.3215311   0.0506414
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment -0.0292211   0.0408885
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB      0.0008149   0.0598102
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD      0.0701336   0.0615705
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE      0.0656138   0.0583410
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ     -0.0141641   0.0558922
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL      0.0121265   0.0558922
##              t value Pr(>|t|)
## (Intercept)       6.349   3e-08 ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$GROUPtreatment  -0.715   0.478
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYB         0.014   0.989
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYD         1.139   0.259
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYE         1.125   0.265
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYJ        -0.253   0.801
## APOP_PLOT7_AGRANULAR_QUAD_PLOT$FAMILYL         0.217   0.829
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1396 on 61 degrees of freedom
## Multiple R-squared:  0.06182,    Adjusted R-squared:  -0.03046
## F-statistic: 0.6699 on 6 and 61 DF,  p-value: 0.6742
APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV_BAD_REMOVED <- lm(APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UL_Arcsine ~
Anova(APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV_BAD_REMOVED, type="II")

## Anova Table (Type II tests)
##
## Response: APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UL_Arcsine
##              Sum Sq Df F value
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.00884  1  0.4085
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY  0.09621  5  0.8896
## Residuals                                1.08157 50
##              Pr(>F)
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP  0.5257
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY  0.4952
## Residuals
summary(APOP_PLOT_7_necrotic_agranular_TWO_WAY_AOV_BAD_REMOVED)

##
## Call:
## lm(formula = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$Q1.UL_Arcsine ~
##     APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUP + APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILY,
##     data = APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.21178 -0.08833 -0.03814  0.03241  0.56375
##
## Coefficients:
##                                     Estimate
## (Intercept)                       0.319117
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.029748
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB        -0.002112
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         0.092793
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         0.093539
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.000804
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         0.028183
##                                     Std. Error
## (Intercept)                       0.055789
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment  0.046545
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB        0.066148
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD        0.068349
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE        0.066148
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ        0.062856
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL        0.066148
##                                     t value Pr(>|t|)
## (Intercept)                       5.720 5.94e-07
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment -0.639  0.526
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB        -0.032  0.975
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD         1.358  0.181
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE         1.414  0.164
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ         0.013  0.990
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL         0.426  0.672
##
## (Intercept) ***
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$GROUPtreatment
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYB
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYD
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYE
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYJ
## APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED$FAMILYL
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1471 on 50 degrees of freedom
## Multiple R-squared:  0.08901,    Adjusted R-squared:  -0.02031
## F-statistic: 0.8142 on 6 and 50 DF,  p-value: 0.564
## #NONE are significant
```

One Way ANOVA of Differences between Families

```
APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_BAD_REMOVED_CHALLENGE
APOP_PLOT_7_necrotic_agranular_oneway_aov <- aov(APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE ~
summary(APOP_PLOT_7_necrotic_agranular_oneway_aov)
```

```
##                                     Df
```

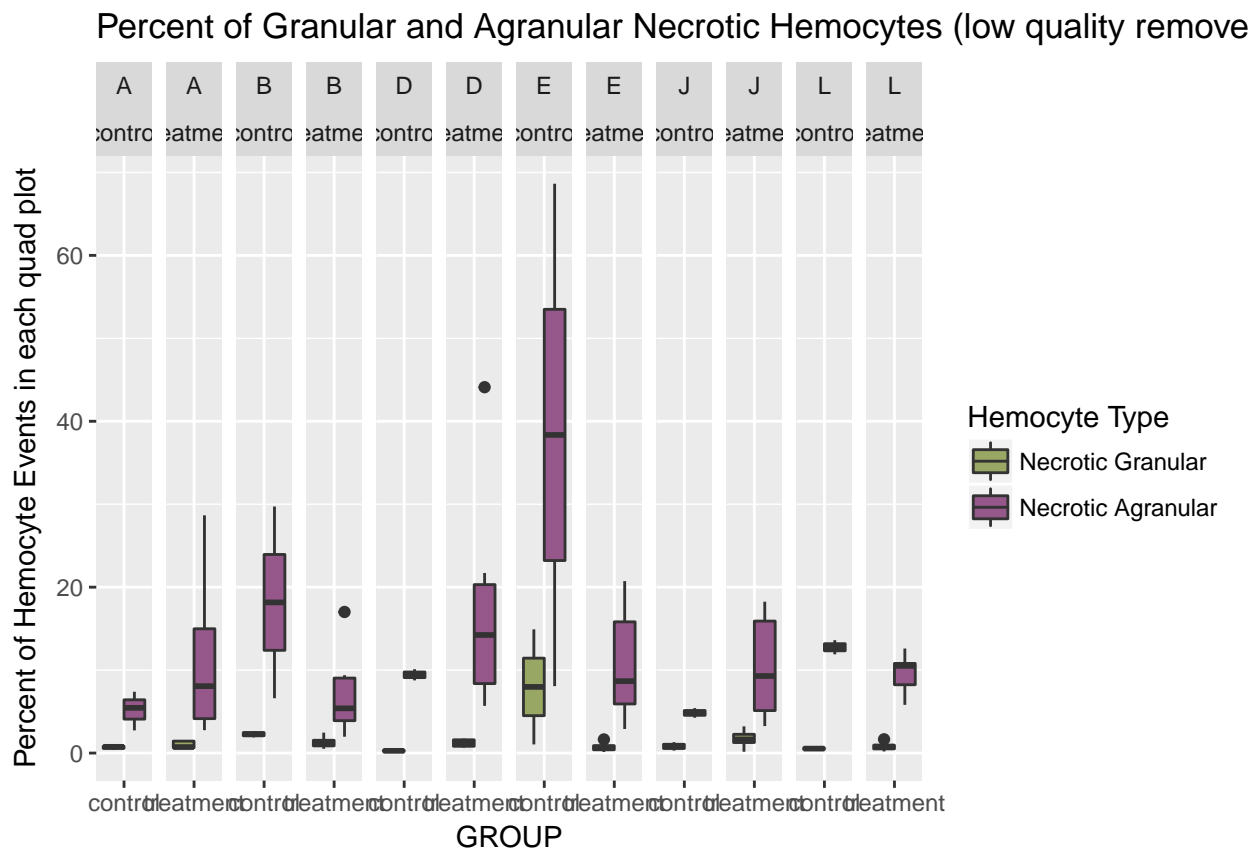


```
## APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 5
## Residuals 38
## Sum Sq
## APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.0824
## Residuals 0.5499
## Mean Sq
## APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.01647
## Residuals 0.01447
## F value
## APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 1.138
## Residuals
## Pr(>F)
## APOP_PLOT_7_necrotic_agranular_hemocytes_BAD_REMOVED_CHALLENGE$FAMILY 0.357
## Residuals
```

Necrotic granular and agranular hemocytes

```
necrotic_granular <- APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED %>% filter(GATE=="Q2_UL")
necrotic_agranular <- APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED %>% filter(GATE=="Q1_UL")
necrotic_granular_agranular_combined <- rbind(necrotic_granular,necrotic_agranular)

ggplot(necrotic_granular_agranular_combined, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=GATE)) + facet_g
scale_fill_manual(name="Hemocyte Type", labels=c("Necrotic Granular", "Necrotic Agranular"), values=c("Necrotic Granular", "Necrotic Agranular"))
```



```
# Two way ANOVA
```

```
necrotic_granular_agranula_aov <- lm(necrotic_granular_agranular_combined$Arcsine ~necrotic_granular_agranular_combined$GROUP)
```

```
Anova(necrotic_granular_agranula_aov, type="II") #GATE is significant
```

```
## Anova Table (Type II tests)
##
## Response: necrotic_granular_agranular_combined$Arcsine
##              Sum Sq Df F value Pr(>F)
## necrotic_granular_agranular_combined$FAMILY 0.05203  5    0.8676 0.5055
## necrotic_granular_agranular_combined$GATE   1.42906  1  119.1371 <2e-16
## Residuals                                1.28347 107
##
## necrotic_granular_agranular_combined$FAMILY
## necrotic_granular_agranular_combined$GATE ***
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(necrotic_granular_agranula_aov)
```

```
##
## Call:
## lm(formula = necrotic_granular_agranular_combined$Arcsine ~ necrotic_granular_agranular_combined$FAMILY +
##   necrotic_granular_agranular_combined$GATE, data = necrotic_granular_agranular_combined)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.19439 -0.05816 -0.00560  0.03376  0.61090
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.083113   0.025504   3.259  0.0015 **
## necrotic_granular_agranular_combined$FAMILYB      0.011444   0.034808   0.329  0.7430
## necrotic_granular_agranular_combined$FAMILYD      0.046753   0.035985   1.299  0.1967
## necrotic_granular_agranular_combined$FAMILYE      0.058477   0.034808   1.680  0.0959 .
## necrotic_granular_agranular_combined$FAMILYJ      0.011826   0.033022   0.358  0.7210
## necrotic_granular_agranular_combined$FAMILYL      0.008207   0.034808   0.236  0.8141
## necrotic_granular_agranular_combined$GATEQ1_UL    0.223925   0.020515  10.915 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1095 on 107 degrees of freedom
## Multiple R-squared:  0.5357, Adjusted R-squared:  0.5097
## F-statistic: 20.58 on 6 and 107 DF, p-value: 6.653e-16
```

```
# Two- Way ANOVA
```

```
necrotic_granular_agranula_aov_interaction <- lm(necrotic_granular_agranular_combined$Arcsine ~ necrotic_granular_agranular_combined$FAMILY +
necrotic_granular_agranular_combined$GATE, data = necrotic_granular_agranular_combined)
Anova(necrotic_granular_agranula_aov_interaction, type="II") #GATE is significant
```

```

## Anova Table (Type II tests)
##
## Response: necrotic_granular_agranular_combined$Arcsine
##
## Sum Sq
## necrotic_granular_agranular_combined$FAMILY 0.05203
## necrotic_granular_agranular_combined$GATE 1.42906
## necrotic_granular_agranular_combined$FAMILY:necrotic_granular_agranular_combined$GATE 0.05716
## Residuals 1.22632
## Df
## necrotic_granular_agranular_combined$FAMILY 5
## necrotic_granular_agranular_combined$GATE 1
## necrotic_granular_agranular_combined$FAMILY:necrotic_granular_agranular_combined$GATE 5
## Residuals 102
## F value
## necrotic_granular_agranular_combined$FAMILY 0.8656
## necrotic_granular_agranular_combined$GATE 118.8633
## necrotic_granular_agranular_combined$FAMILY:necrotic_granular_agranular_combined$GATE 0.9508
## Residuals
## Pr(>F)
## necrotic_granular_agranular_combined$FAMILY 0.5070
## necrotic_granular_agranular_combined$GATE <2e-16
## necrotic_granular_agranular_combined$FAMILY:necrotic_granular_agranular_combined$GATE 0.4517
## Residuals
##
## necrotic_granular_agranular_combined$FAMILY
## necrotic_granular_agranular_combined$GATE ***
## necrotic_granular_agranular_combined$FAMILY:necrotic_granular_agranular_combined$GATE
## Residuals
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

summary(necrotic_granular_agranula_aov_interaction)

##
## Call:
## lm(formula = necrotic_granular_agranular_combined$Arcsine ~ necrotic_granular_agranular_combined$FAMILYB + necrotic_granular_agranular_combined$FAMILYD + necrotic_granular_agranular_combined$FAMILYE + necrotic_granular_agranular_combined$FAMILYJ + necrotic_granular_agranular_combined$FAMILYL + necrotic_granular_agranular_combined$GATEQ1_UL, data = necrotic_granular_agranular_combined)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.21839 -0.05770 -0.01051  0.02622  0.58689
##
## Coefficients:
##
## (Intercept) 0.09267
## necrotic_granular_agranular_combined$FAMILYB 0.02650
## necrotic_granular_agranular_combined$FAMILYD 0.00139
## necrotic_granular_agranular_combined$FAMILYE 0.02492
## necrotic_granular_agranular_combined$FAMILYJ 0.02555
## necrotic_granular_agranular_combined$FAMILYL -0.01027
## necrotic_granular_agranular_combined$GATEQ1_UL 0.20481
## necrotic_granular_agranular_combined$FAMILYB:necrotic_granular_agranular_combined$GATEQ1_UL -0.03012
## necrotic_granular_agranular_combined$FAMILYD:necrotic_granular_agranular_combined$GATEQ1_UL 0.09073
## necrotic_granular_agranular_combined$FAMILYE:necrotic_granular_agranular_combined$GATEQ1_UL 0.06712

```

```

## necrotic_granular_agranular_combined$FAMILYJ:necrotic_granular_agranular_combined$GATEQ1_UL -0.02745
## necrotic_granular_agranular_combined$FAMILYL:necrotic_granular_agranular_combined$GATEQ1_UL 0.03695
## Std. Err
## (Intercept) 0.033
## necrotic_granular_agranular_combined$FAMILYB 0.049
## necrotic_granular_agranular_combined$FAMILYD 0.050
## necrotic_granular_agranular_combined$FAMILYE 0.049
## necrotic_granular_agranular_combined$FAMILYJ 0.046
## necrotic_granular_agranular_combined$FAMILYL 0.049
## necrotic_granular_agranular_combined$GATEQ1_UL 0.046
## necrotic_granular_agranular_combined$FAMILYB:necrotic_granular_agranular_combined$GATEQ1_UL 0.069
## necrotic_granular_agranular_combined$FAMILYD:necrotic_granular_agranular_combined$GATEQ1_UL 0.072
## necrotic_granular_agranular_combined$FAMILYE:necrotic_granular_agranular_combined$GATEQ1_UL 0.069
## necrotic_granular_agranular_combined$FAMILYJ:necrotic_granular_agranular_combined$GATEQ1_UL 0.066
## necrotic_granular_agranular_combined$FAMILYL:necrotic_granular_agranular_combined$GATEQ1_UL 0.069
## t value
## (Intercept) 2.803
## necrotic_granular_agranular_combined$FAMILYB 0.538
## necrotic_granular_agranular_combined$FAMILYD 0.027
## necrotic_granular_agranular_combined$FAMILYE 0.506
## necrotic_granular_agranular_combined$FAMILYJ 0.547
## necrotic_granular_agranular_combined$FAMILYL -0.208
## necrotic_granular_agranular_combined$GATEQ1_UL 4.381
## necrotic_granular_agranular_combined$FAMILYB:necrotic_granular_agranular_combined$GATEQ1_UL -0.432
## necrotic_granular_agranular_combined$FAMILYD:necrotic_granular_agranular_combined$GATEQ1_UL 1.259
## necrotic_granular_agranular_combined$FAMILYE:necrotic_granular_agranular_combined$GATEQ1_UL 0.963
## necrotic_granular_agranular_combined$FAMILYJ:necrotic_granular_agranular_combined$GATEQ1_UL -0.415
## necrotic_granular_agranular_combined$FAMILYL:necrotic_granular_agranular_combined$GATEQ1_UL 0.530
## Pr(>|t|)
## (Intercept) 0.00606
## necrotic_granular_agranular_combined$FAMILYB 0.59192
## necrotic_granular_agranular_combined$FAMILYD 0.97830
## necrotic_granular_agranular_combined$FAMILYE 0.61423
## necrotic_granular_agranular_combined$FAMILYJ 0.58591
## necrotic_granular_agranular_combined$FAMILYL 0.83540
## necrotic_granular_agranular_combined$GATEQ1_UL 2.88e-05
## necrotic_granular_agranular_combined$FAMILYB:necrotic_granular_agranular_combined$GATEQ1_UL 0.66658
## necrotic_granular_agranular_combined$FAMILYD:necrotic_granular_agranular_combined$GATEQ1_UL 0.21084
## necrotic_granular_agranular_combined$FAMILYE:necrotic_granular_agranular_combined$GATEQ1_UL 0.33782
## necrotic_granular_agranular_combined$FAMILYJ:necrotic_granular_agranular_combined$GATEQ1_UL 0.67888
## necrotic_granular_agranular_combined$FAMILYL:necrotic_granular_agranular_combined$GATEQ1_UL 0.59719
##
## (Intercept) **
## necrotic_granular_agranular_combined$FAMILYB
## necrotic_granular_agranular_combined$FAMILYD
## necrotic_granular_agranular_combined$FAMILYE
## necrotic_granular_agranular_combined$FAMILYJ
## necrotic_granular_agranular_combined$FAMILYL
## necrotic_granular_agranular_combined$GATEQ1_UL ***
## necrotic_granular_agranular_combined$FAMILYB:necrotic_granular_agranular_combined$GATEQ1_UL
## necrotic_granular_agranular_combined$FAMILYD:necrotic_granular_agranular_combined$GATEQ1_UL
## necrotic_granular_agranular_combined$FAMILYE:necrotic_granular_agranular_combined$GATEQ1_UL
## necrotic_granular_agranular_combined$FAMILYJ:necrotic_granular_agranular_combined$GATEQ1_UL
## necrotic_granular_agranular_combined$FAMILYL:necrotic_granular_agranular_combined$GATEQ1_UL

```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1096 on 102 degrees of freedom
## Multiple R-squared:  0.5564, Adjusted R-squared:  0.5086
## F-statistic: 11.63 on 11 and 102 DF,  p-value: 8.869e-14
necgate1<-filter(necrotic_granular_agranular_combined, GATE=="Q1_UL")
necgate2<-filter(necrotic_granular_agranular_combined, GATE=="Q2_UL")
t.test(necgate1$Arcsine,necgate2$Arcsine)

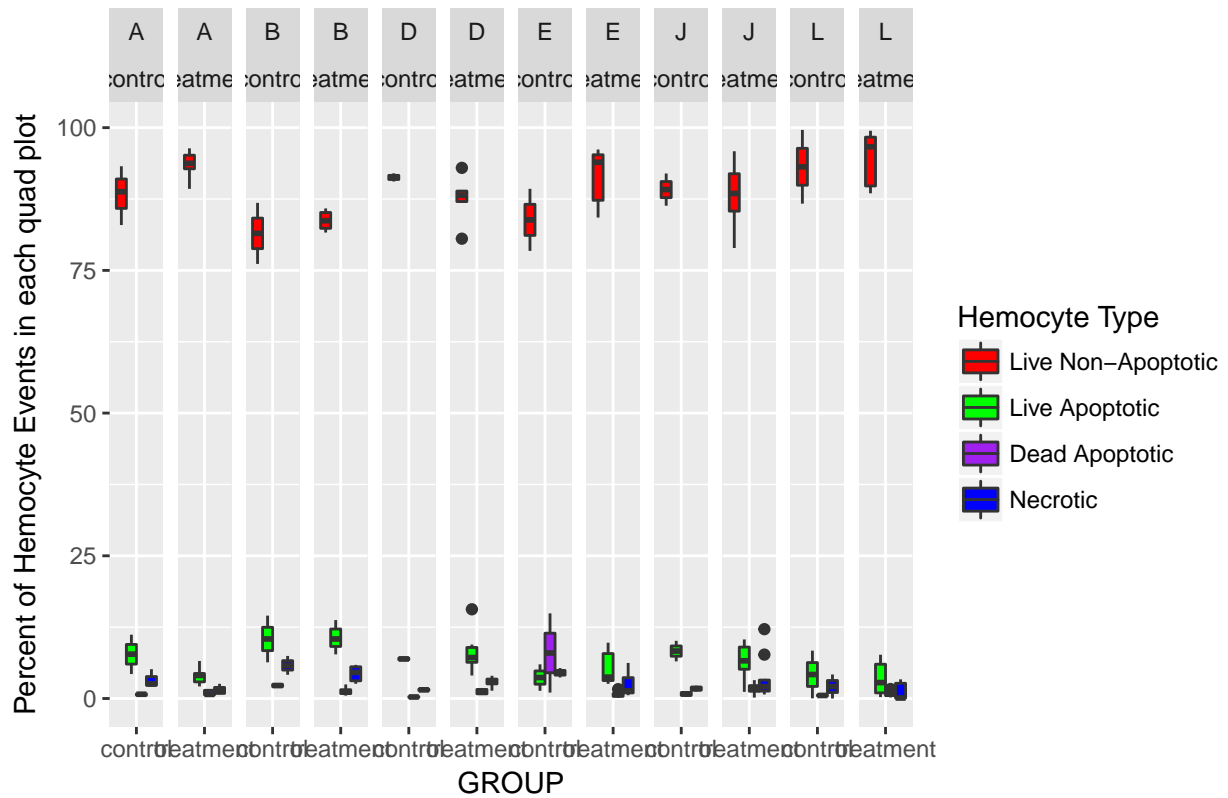
##
## Welch Two Sample t-test
##
## data:  necgate1$Arcsine and necgate2$Arcsine
## t = 10.947, df = 69.772, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1831273 0.2647229
## sample estimates:
## mean of x mean of y
## 0.3282181 0.1042931
necrotic_granular_agranula_aov_interaction_least_squares <- lsmeans(necrotic_granular_agranula_aov_inter
cld(necrotic_granular_agranula_aov_interaction_least_squares, alpha=0.05, Letters=letters) # the means o

## necrotic_granular_agranular_combined$GATE      lsmean      SE df
## Q2_UL                                           0.09266923 0.03306015 102
## Q1_UL                                           0.09708619 0.02821554 102
## lower.CL upper.CL .group
## 0.02709457 0.1582439  a
## 0.04112080 0.1530516  a
##
## Results are averaged over the levels of: necrotic_granular_agranular_combined$FAMILY
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

Combined Faceted all parameters by cell type

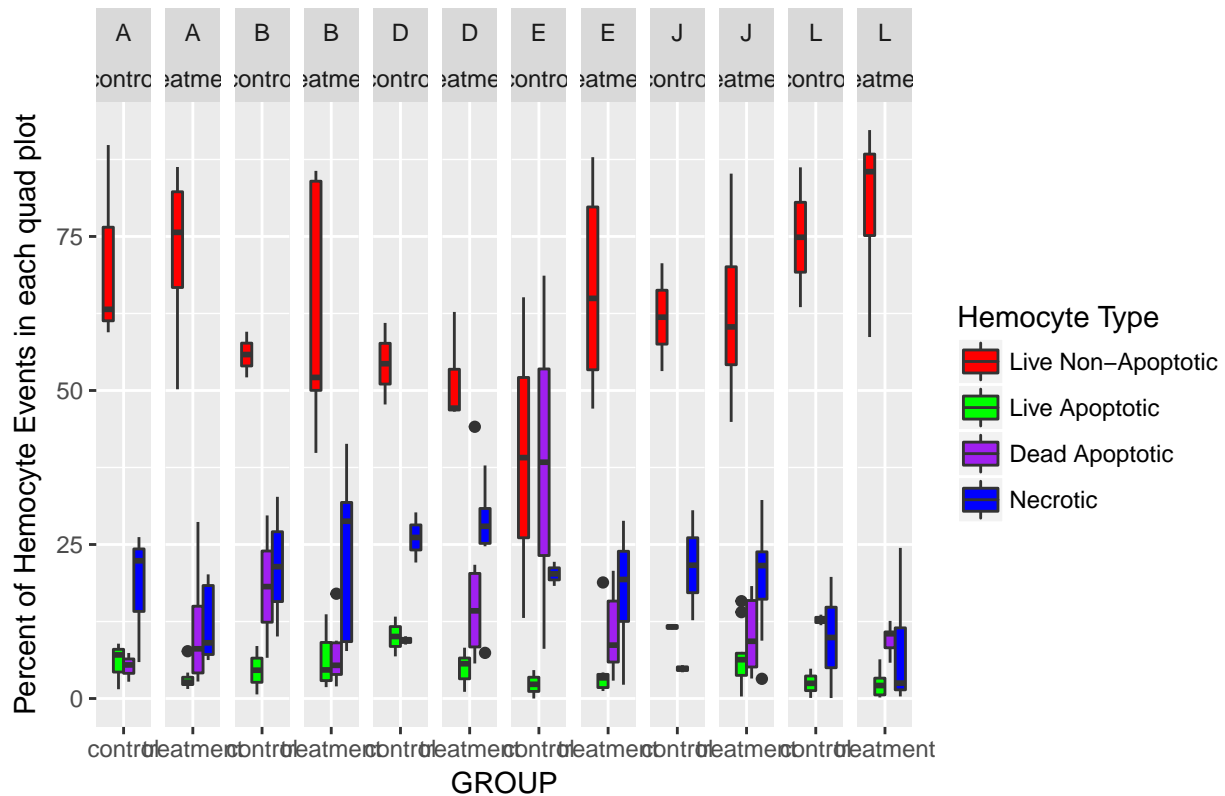
```
ggplot(APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=
```

Percent of Granular Hemocytes in each Quadrant (low quality removed)



```
ggplot(APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=Hemocyte Type))
```

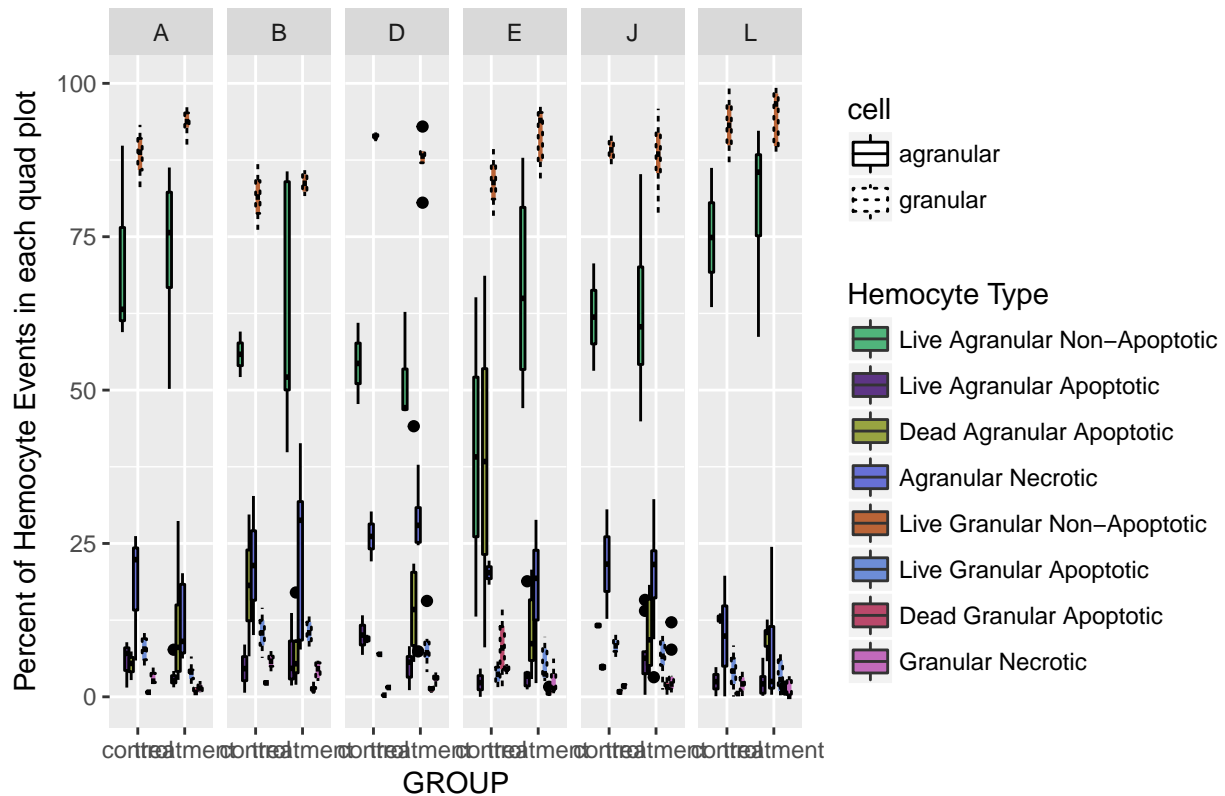
Percent of Agranular Hemocytes in each Quadrant (low quality removed)



```
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$cell <- "agranular"
APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED$cell <- "granular"
full_Data <- rbind(APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED, APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED)

ggplot(full_Data, aes(x=GROUP, y=PERCENT_OF_THIS_PLOT, fill=GATE, linetype=cell, color=cell)) + facet_grid(.~GATE) +
  ggtitle("Percent of Granular and Agranular Hemocytes in each Quadrant (low quality removed)") +
  geom_boxplot() +
  ylab("Percent of Hemocyte Events in each quad plot") +
  scale_fill_manual(name="Hemocyte Type", labels=c("Live Agranular Non-Apoptotic", "Live Agranular Apoptotic", "Dead Agranular Apoptotic", "Necrotic")) +
  scale_color_manual(values=c("granular"="black", "agranular"="black"))
```

Percent of Granular and Agranular Hemocytes in each Quadrant (low quali



Calculate Summary Statistics

```
full_combined <- rbind(APOP_PLOT4_GRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED,
APOP_PLOT7_AGRANULAR_QUAD_PLOT_GATE_ADDED_BAD_REMOVED)
```

```
full_statistics <- summarySE(data=full_combined, "PERCENT_OF_THIS_PLOT", groupvars=c("GATE",
"GROUP", "cell", "FAMILY"), conf.interval= 0.95)
```