2A & B: Pond Water Microbes

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# Load in data and libraries

## read in and clean data  
library(tidyverse) # for cleaning and viewing data  
library(gt) # pretty stats tables  
library(broom) # cleaning for gt  
library(here) # for importing data  
library(car) # stats tests like Levene's  
library(multcomp) # stats  
library(multcompView) # view cld  
library(emmeans) # for pairwise comparisons, especially on mixed effects models and glms  
library(ggpubr) # for making ggqq plot  
library(patchwork) # for combining figures  
  
# load data  
fs\_pw\_bd <- read.csv(here("data", "fifteen-sites-PW-on-Bd - Sheet1.csv"))  
fig\_2b\_raw <- read.csv(here("data", "final\_NCOS\_2024\_reformatted\_for\_R.xlsx - Fig2B.csv"))  
  
# Colors: these are from Paul Tol's colorblind friendly palette  
with\_microbes\_40\_color <- "#999933"  
no\_microbes\_.22\_color <- "#88ccee"  
  
# set up custom theme  
myCustomTheme <- function() {  
 theme\_light() +  
 theme(axis.text = element\_text(size = 12, family = "Times", color = "black"),  
 axis.title.x = element\_text(margin = margin(t = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between x-axis label and axis  
 axis.title.y = element\_text(margin = margin(r = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between y-axis label and axis  
 title = element\_text(size = 12, face = "bold", family = "Times"),  
 plot.caption = element\_text(size = 10, face = "italic", family = "Times"),  
 legend.text = element\_text(size = 10, family = "Times"), # Increase legend text size  
 panel.grid.major.x = element\_blank(), # Remove major vertical grid lines  
 panel.grid.minor.x = element\_blank(), # Remove minor vertical grid lines  
 panel.grid.major.y = element\_blank(), # Remove major horizontal grid lines  
 panel.grid.minor.y = element\_blank(), # Remove minor horizontal grid lines  
 strip.text = element\_text(size = 12, face = "bold", family = "Times", color = "black"), # Set strip text style  
 strip.background = element\_rect(fill = "white", color = "grey"), # Set strip background to white, # color = "black"  
 axis.ticks = element\_blank() # Remove x and y axis ticks  
 )}

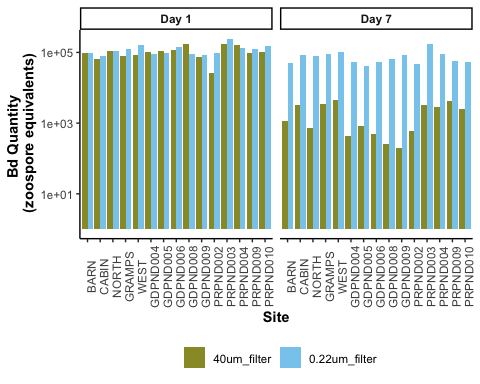
# 2A

## Data Wrangling

# remove controls  
eb\_pw <- fs\_pw\_bd %>% filter(site != "sterile MQ")  
  
# keep control for labeling plot  
eb\_pw\_controls <- fs\_pw\_bd %>%   
 filter(site =="sterile MQ") %>%   
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
 mutate(day = case\_when(  
 day == 1 ~ "Day\_1",  
 day == 7 ~ "Day\_7"))  
  
# data type cleaning  
eb\_pw$bd\_location <- factor(eb\_pw$bd\_location, levels = c("floating", "adherent"))  
eb\_pw$filter <- factor(eb\_pw$filter,  
 levels = c("40um\_filter", "0.22um\_filter"))  
eb\_pw$day <- factor(eb\_pw$day, levels = c("1", "7"),  
 labels = c("Day\_1", "Day\_7"))  
eb\_pw$site <- factor(eb\_pw$site,  
 levels = c("BARN", "CABIN", "NORTH", "GRAMPS", "WEST", "GDPND004", "GDPND005", "GDPND006", "GDPND008", "GDPND009", "PRPND002", "PRPND003", "PRPND004", "PRPND009", "PRPND010", "sterile MQ"))  
  
# get the total difference across days by combining both locations of Bd then subtracting across days  
eb\_pw\_total\_diff <- eb\_pw %>%  
 # combine floating and adherent for total\_Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
 subset(select = -c(adherent,floating)) %>%   
  
# different metrics of difference in Bd  
 pivot\_wider(names\_from = day, values\_from = combined\_bd) %>%  
  
 # calculate the rate loss by taking the log of each before subtracting  
 mutate(rate\_loss = log(Day\_1) - log(Day\_7))  
  
# Split into 2 data frames one for 40 and one for .22  
eb\_pw\_total\_diff\_40um <- eb\_pw\_total\_diff %>%   
 filter(filter =="40um\_filter")  
eb\_pw\_total\_diff.22um <- eb\_pw\_total\_diff%>%   
 filter(filter =="0.22um\_filter")

## EDA

# Renwei barplot remake  
eb\_pw %>%  
 # combine floating and adherent for total\_Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
ggplot(aes(y= combined\_bd, x = site, fill = filter)) +   
 geom\_col(position = position\_dodge()) +  
 scale\_y\_log10() +  
 facet\_wrap(~day, labeller = labeller(day = c("Day\_1" = "Day 1",  
 "Day\_7" = "Day 7"))) +  
 scale\_fill\_manual(values = c("40um\_filter" = with\_microbes\_40\_color,   
 "0.22um\_filter" = no\_microbes\_.22\_color)) +  
 theme\_classic() +  
 theme(axis.text.x = element\_text(angle = 90),  
 legend.position = "bottom",  
 strip.text = element\_text(face="bold"),  
 axis.title = element\_text(face = "bold")) +   
 xlab("Site") +  
 ylab("Bd Quantity \n (zoospore equivalents)") +  
 guides(fill=guide\_legend(title=""))



Boxplot

# eb\_pw %>%  
# # combine floating and adherent for total\_Bd  
# pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
# mutate(combined\_bd = adherent + floating) %>%   
#   
# # create the plot  
# ggplot(aes(y= combined\_bd, x = filter, fill = filter)) +   
# geom\_boxplot() +  
# geom\_jitter(width = 0.2, alpha = 0.3) +  
# scale\_y\_log10() +  
# facet\_wrap(~day, labeller = labeller(day = c("Day\_1" = "Day 1",  
# "Day\_7" = "Day 7")))+  
# scale\_fill\_manual(values = c("40um\_filter" = with\_microbes\_40\_color,   
# "0.22um\_filter" = no\_microbes\_.22\_color)) +  
# theme\_classic() +  
# theme(legend.position = "none",  
# strip.text = element\_text(face="bold"),  
# axis.title = element\_text(face = "bold")) +   
# scale\_x\_discrete (labels= c("40um\_filter" = "With Microbes", "0.22um\_filter" = "No Microbes")) +  
# xlab("Presence of Microbes in Pond Water") +  
# ylab("Bd Quantity \n (zoospore equivalents)") +  
#   
# # add controls ad x's  
# geom\_point(data = eb\_pw\_controls, aes(x = filter, y = combined\_bd), shape = 4, size = 2)

## Stats and assumption testing

**Statistical question**: Is there a difference in the **rate of gain or loss of Bd over 6 days** between the **filter sizes** looking at the **TOTAL BD**

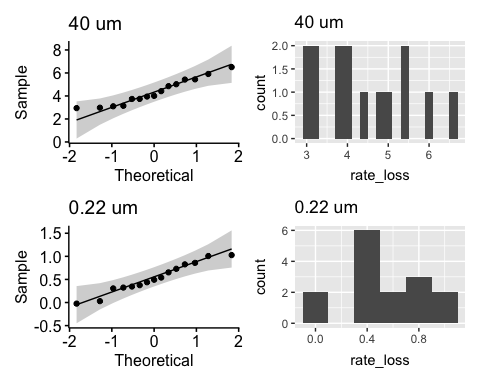
The samples are essentially paired by site, so a paired t-test is most appropriate

Assumptions:

Assumes that the observations from each group represent a random sample from the population. Assumes that the difference of the two observations follow a normal distribution.

Assumption testing:

# check normality of the differences across groups  
  
# numeric check  
eb\_pw\_40um\_shapiro.test <- shapiro.test(eb\_pw\_total\_diff\_40um$rate\_loss) # normal, yay!  
eb\_pw\_0.22um\_shapiro.test <- shapiro.test(eb\_pw\_total\_diff.22um$rate\_loss) # normal, yay!  
  
# visual check  
eb\_pw\_40um\_qq <- eb\_pw\_total\_diff\_40um %>%   
 ggqqplot("rate\_loss", title = "40 um")  
  
# Histogram using ggplot2  
eb\_pw\_40um\_hist <- eb\_pw\_total\_diff\_40um %>%   
 ggplot(aes(x = rate\_loss)) +  
 geom\_histogram(binwidth = 0.2) +  
 labs(title = "40 um")  
  
# visual check  
eb\_pw\_0.22um\_qq <- eb\_pw\_total\_diff.22um %>%   
 ggqqplot("rate\_loss", title = "0.22 um")  
  
# Histogram using ggplot2  
eb\_pw\_0.22um\_hist <- eb\_pw\_total\_diff.22um %>%   
 ggplot(aes(x = rate\_loss)) +  
 geom\_histogram(binwidth = 0.2) +  
 labs(title = "0.22 um")  
  
eb\_pw\_40um\_qq + eb\_pw\_40um\_hist + eb\_pw\_0.22um\_qq + eb\_pw\_0.22um\_hist



eb\_pw\_40um\_shapiro.test

Shapiro-Wilk normality test  
  
data: eb\_pw\_total\_diff\_40um$rate\_loss  
W = 0.93591, p-value = 0.3337

eb\_pw\_0.22um\_shapiro.test

Shapiro-Wilk normality test  
  
data: eb\_pw\_total\_diff.22um$rate\_loss  
W = 0.96119, p-value = 0.7131

The data for the 40um filter is normally distributed (Shapiro-Wilk test, W = 0.93591, p = 0.3337), and so is the data for the 0.22 filter (Shapiro-Wilk test, W = 0.96119, p = 0.7131).

# Run the paired t-test on the difference  
eb\_pw\_paired\_ttest\_result <- t.test(eb\_pw\_total\_diff\_40um$rate\_loss, eb\_pw\_total\_diff.22um$rate\_loss, paired = TRUE)  
  
eb\_pw\_paired\_ttest\_result

Paired t-test  
  
data: eb\_pw\_total\_diff\_40um$rate\_loss and eb\_pw\_total\_diff.22um$rate\_loss  
t = 12.449, df = 14, p-value = 5.83e-09  
alternative hypothesis: true mean difference is not equal to 0  
95 percent confidence interval:  
 3.159637 4.474996  
sample estimates:  
mean difference   
 3.817316

**There is a significant difference in the change in the total quantity of Bd from Day 1 to Day 7 across the filter types (t = 12.4488129, df = 14, p-value = 5.8299032^{-9})**

The t-value is positive, which shows that the first item entered (with microbes) has a larger loss of Bd than the second item entered (no microbes.) Df of 14 is expected, because it’s 15 sites.

# 2b

## Data wrangling

pw <- fig\_2b\_raw %>%   
# add column for microbes or no  
 mutate(microbes = case\_when(  
 str\_detect(sample\_ID, "\\+microorganism") ~ "y",  
 TRUE ~ "n"  
 )) %>%   
# add column for water\_treatment  
 mutate(water\_treatment = case\_when(  
 sample\_ID %in% c("1%TB", "MQ", "Added Bd") ~ "sterile-water",  
 sample\_ID %in% c("1%TB+PW+microorganism", "PW+microorganism") ~ "PW+MO",  
 sample\_ID %in% c("1%TB+PW-microorganism", "PW-microorganism") ~ "PW-MO"  
 )) %>%   
# add column for TB or no  
 mutate(TB = case\_when(  
 str\_detect(sample\_ID, "TB") ~ "y",  
 TRUE ~ "n"  
 )) %>%   
 # update day to have day in it  
 mutate(day = case\_when(  
 day == 1 ~ "Day\_1",  
 day == 3 ~ "Day\_3",  
 day == 5 ~ "Day\_5",  
 day == 7 ~ "Day\_7",  
 day == 0 ~ "Day\_0" # In case you want to include Day\_0 as well  
 )) %>%   
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day))))  
  
pw\_summary <- pw %>%   
 group\_by(day, sample\_ID) %>%   
 reframe(mean = mean(adh\_plus\_sup), # calculate the mean  
 n = length(adh\_plus\_sup), # count the number of observations  
 df = n - 1, # calculate the degrees of freedom  
 sd = sd(adh\_plus\_sup), # calculate the standard deviation  
 se = sd/sqrt(n), # calculate the standard error  
 ) %>%   
 mutate(microbes = case\_when(  
 str\_detect(sample\_ID, "\\+microorganism") ~ "y",TRUE ~ "n")) %>%   
 # add column for TB or no  
 mutate(TB = case\_when(str\_detect(sample\_ID, "TB") ~ "y", TRUE ~ "n")) %>%   
 # add column for PW or no  
 mutate(water\_treatment = case\_when(  
 sample\_ID %in% c("1%TB", "MQ", "Added Bd") ~ "sterile-water",  
 sample\_ID %in% c("1%TB+PW+microorganism", "PW+microorganism") ~ "PW+MO",  
 sample\_ID %in% c("1%TB+PW-microorganism", "PW-microorganism") ~ "PW-MO"  
 )) %>%   
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day))))  
  
# datafram of only controls  
pw\_control\_data <- pw %>%  
 filter(day == "Day\_0") %>%   
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day)))) %>%   
 dplyr::select(day, adh\_plus\_sup, day\_numeric)  
  
# dataframe without controls  
pw\_noday0 <- pw %>%  
 filter(day != "Day\_0") %>%  
 mutate(log\_adh\_plus\_sup = log(adh\_plus\_sup)) # note: no zeroes so not log + 1  
  
# do we want it ordered? read the stats thing Tatum sent  
pw\_noday0 <- pw\_noday0 %>%   
mutate(day = factor(day,   
 levels = c("Day\_1", "Day\_3", "Day\_5", "Day\_7")))  
str(pw\_noday0$day)

Factor w/ 4 levels "Day\_1","Day\_3",..: 1 2 3 4 1 2 3 4 1 2 ...

# set MQ as reference  
pw\_noday0$sample\_ID <- factor(pw\_noday0$sample\_ID)  
pw\_noday0$sample\_ID <- relevel(pw\_noday0$sample\_ID, ref = "MQ")  
  
# set sterile water as reference  
pw\_noday0$water\_treatment <- factor(pw\_noday0$water\_treatment)  
pw\_noday0$water\_treatment <- relevel(pw\_noday0$water\_treatment, ref = "sterile-water")  
  
# set no TB as reference  
pw\_noday0$TB <- factor(pw\_noday0$TB)  
pw\_noday0$TB <- relevel(pw\_noday0$TB, ref = "n")  
  
# set no microbes as reference  
pw\_noday0$microbes <- factor(pw\_noday0$microbes)  
pw\_noday0$microbes <- relevel(pw\_noday0$microbes, ref = "n")

Renwei’s figure

|  |
| --- |
|  |

Caitlin’s version

fig\_2b <- pw\_summary %>%   
 # reorder to match Renwei's plot  
 mutate(sample\_ID = factor(sample\_ID,   
 levels = c("1%TB", "MQ", "1%TB+PW+microorganism", "PW+microorganism", "1%TB+PW-microorganism", "PW-microorganism", "Added Bd"))) %>%   
  
 ggplot(aes(x = day\_numeric,   
 y = mean,   
 color = sample\_ID)) +  
 geom\_point(size = 2) +  
 geom\_errorbar(aes(ymin = mean - se, # plot the standard error  
 ymax = mean + se),  
 width = 0.1) +  
 scale\_y\_log10(limits = c(1e3, 1e8),   
 breaks = c(1e3, 1e4, 1e5, 1e6, 1e7, 1e8)) +  
 # vibes  
 # vibes  
 labs(x = "Day",  
 y = "Bd Quantity per sample (ZE/well)",  
 color = "Medium", # Title for color legend  
 linetype = "Microbes Present" # Title for linetype legend  
 ) +  
 scale\_color\_manual(values = c("1%TB" = "#CCBB44",   
 "MQ" = "#228833",   
 "1%TB+PW+microorganism" = "#4477AA",   
 "PW+microorganism" = "#EE6677",   
 "1%TB+PW-microorganism" = "#66CCEE",  
 #"Added Bd" = "#BBBBBB" # removed bc not really a medium  
 "PW-microorganism" = "#AA3377"), # Assign specific colors to match RC's plot  
 labels = c("1%TB" = "TB",  
 "MQ" = "MQ",  
 "1%TB+PW+microorganism" = "TB + PW + MO",  
 "PW+microorganism" = "PW + MO",  
 "1%TB+PW-microorganism" = "TB + PW - MO",  
 "PW-microorganism" = "PW - MO",  
 "Added Bd" = "Initial Bd")) + # Custom labels for the color legend  
 geom\_line(aes(linetype = microbes)) +   
 scale\_linetype\_manual(values = c("n" = "dashed",   
 "y" = "solid"),  
 labels = c("n" = "N", "y" = "Y")) + # Change labels to uppercase N and Y  
 myCustomTheme()+  
 scale\_x\_continuous(breaks = c(0, 1, 3, 5, 7),  
 labels = c("Initial\nBd", "1", "3", "5", "7"))  
 theme(legend.position = "right") # Adjust the legend position to overlap with the plot

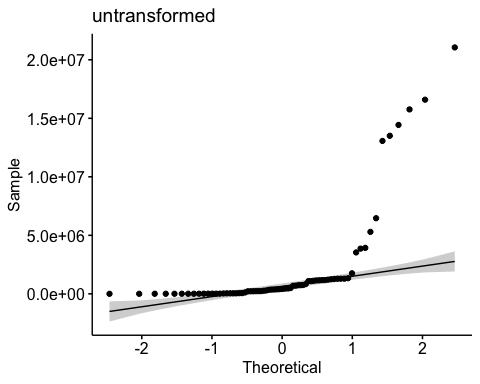
## 2b EDA

visualize y var: bd load

log transformed will get me closer to normal, note we only need to worry about the residuals normality though, so commented out the transformation of the data for space

TRY ARCSIN, TRY OTHER THINGS

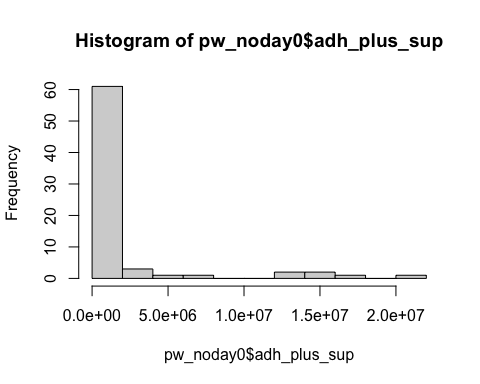
# untransformed  
ggqqplot(pw\_noday0, "adh\_plus\_sup", title = "untransformed")



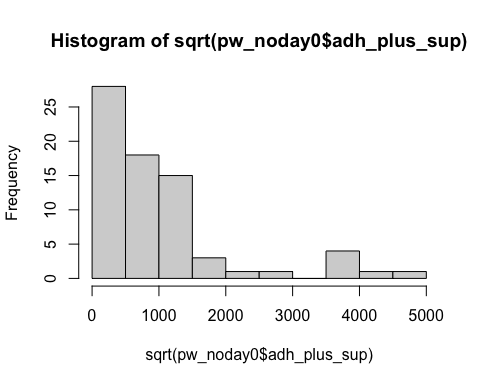
shapiro.test(pw\_noday0$adh\_plus\_sup) # nope

Shapiro-Wilk normality test  
  
data: pw\_noday0$adh\_plus\_sup  
W = 0.49498, p-value = 2.434e-14

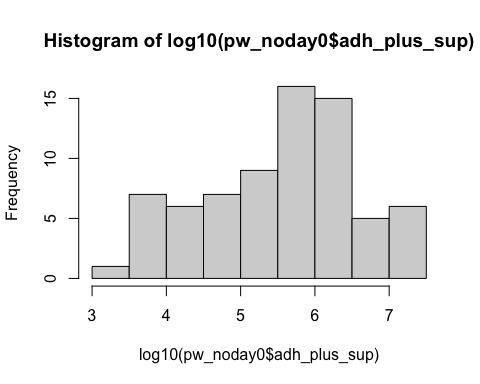
hist(pw\_noday0$adh\_plus\_sup) # note



# sqrt  
hist(sqrt(pw\_noday0$adh\_plus\_sup)) # nope



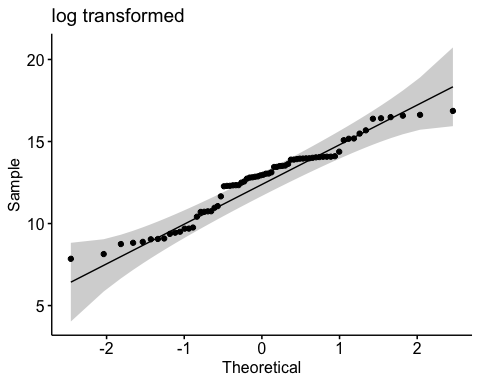
# log 10  
hist(log10(pw\_noday0$adh\_plus\_sup)) # much better...?



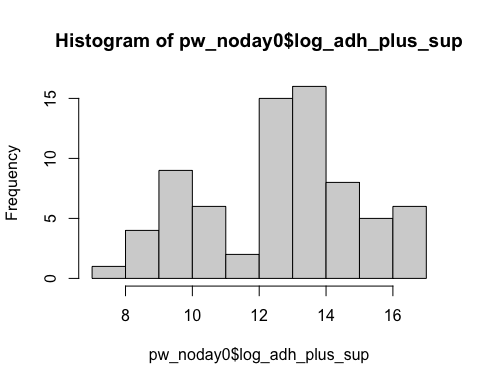
shapiro.test(log10(pw\_noday0$adh\_plus\_sup)) # closer

Shapiro-Wilk normality test  
  
data: log10(pw\_noday0$adh\_plus\_sup)  
W = 0.95623, p-value = 0.01361

# TRY ARCSIN  
  
  
# log transformed  
ggqqplot(pw\_noday0, "log\_adh\_plus\_sup", title = "log transformed") # gorgeous



hist(pw\_noday0$log\_adh\_plus\_sup) # better



shapiro.test(pw\_noday0$log\_adh\_plus\_sup) # p-value = 0.01361, does not pass shapiro, but this has an n of 72 which is more than the recommended <50 samples

Shapiro-Wilk normality test  
  
data: pw\_noday0$log\_adh\_plus\_sup  
W = 0.95623, p-value = 0.01361

# visualize comparisons  
# TB y or n  
# pw\_noday0 %>%   
# ggplot(aes(x = TB,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()  
# # water\_treat  
# pw\_noday0 %>%   
# ggplot(aes(x = water\_treatment,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()  
# # day  
# pw\_noday0 %>%   
# ggplot(aes(x = day,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()

## 2b Stats

Most appropriate comaprison for study design: day*microbes*water\_treatment

* y variable: amount of Bd
* x vars: day, TB y/n, water\_treatment (pw with microbes, pw without, sterile water)

Question: Does the amount of Bd in the sample differ across the treatments of presence of water type (pw with microbes, pw without, sterile water), TB, and day?

Model: 2-way anova

Note: anovas, lm’s and glm’s are all linear models!

Note: whether the factor of day is ordered does not make a difference, see the appendix

## null

null <- lm(log\_adh\_plus\_sup ~ 1,  
 data = pw\_noday0)  
AIC(null) #326.4356

[1] 326.4356

## Try ANOVA with interactions: Bd ~ day\*TB\*water\_treatment

**important: this ANOVA does not have perfectly normally distributed residuals, but it is the best tool we have right now to answer our question**

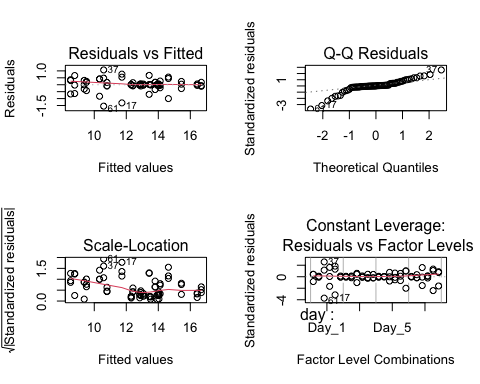
Tatum says it is normal enough to proceed.

Other option to try: arcsin transformation

Other option to try: poisson glm on untransformed data

Note: Kruskall wallace isn’t the best move here because I want interactions, if I cut the interactions, a normal anova works, so no need for a KW.

# log transformed  
aov\_2b <- aov(log\_adh\_plus\_sup ~ day\*TB\*water\_treatment,  
 data = pw\_noday0)  
  
# diagnostic plot  
par(mfrow = c(2,2))  
plot(aov\_2b) # qq is sus



AIC(aov\_2b) # better than null 127.7922

[1] 127.7922

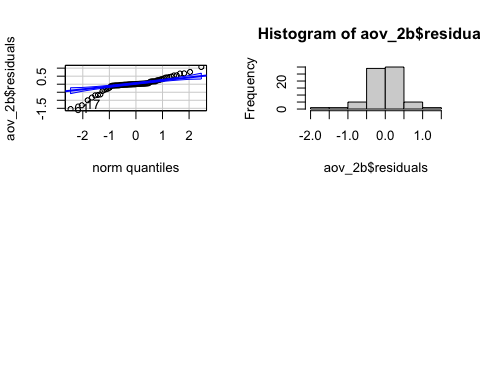
# make qq in car with 95% CI  
qqPlot(aov\_2b$residuals) # not good

[1] 61 17

hist(aov\_2b$residuals) # but this looks great!! what's happening here?  
shapiro.test(aov\_2b$residuals) # does not pass but it is over the 50

Shapiro-Wilk normality test  
  
data: aov\_2b$residuals  
W = 0.879, p-value = 4.861e-06

# # sqrt transformed, did not work!  
# mod5 <- aov(sqrt(adh\_plus\_sup) ~ day\*TB\*water\_treatment,  
# data = pw\_noday0)  
#   
# # diagnostic plot  
# par(mfrow = c(2,2))  
# plot(mod5) # NOT normal...  
# AIC(mod5) # horrible 968.6406  
#   
# # make qq in car with 95% CI  
# qqPlot(mod5$residuals)



## anova results

# interpret results  
summary(aov\_2b)

Df Sum Sq Mean Sq F value Pr(>F)   
day 3 35.40 11.80 45.608 4.31e-14 \*\*\*  
TB 1 20.99 20.99 81.127 6.92e-12 \*\*\*  
water\_treatment 2 228.85 114.42 442.251 < 2e-16 \*\*\*  
day:TB 3 11.71 3.90 15.084 4.78e-07 \*\*\*  
day:water\_treatment 6 37.33 6.22 24.047 6.45e-13 \*\*\*  
TB:water\_treatment 2 0.06 0.03 0.109 0.897   
day:TB:water\_treatment 6 24.57 4.09 15.825 6.30e-10 \*\*\*  
Residuals 48 12.42 0.26   
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

### post hoc

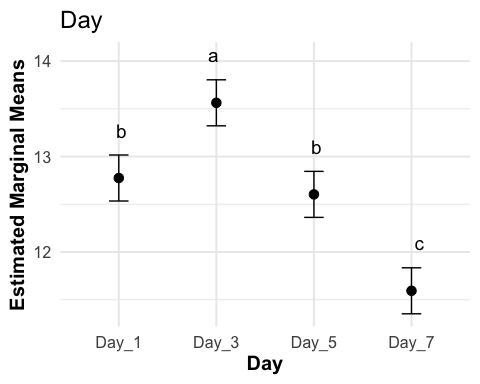
# post hoc  
TukeyHSD(aov\_2b)

Tukey multiple comparisons of means  
 95% family-wise confidence level  
  
Fit: aov(formula = log\_adh\_plus\_sup ~ day \* TB \* water\_treatment, data = pw\_noday0)  
  
$day  
 diff lwr upr p adj  
Day\_3-Day\_1 0.7878386 0.3365970 1.2390802 0.0001521  
Day\_5-Day\_1 -0.1715069 -0.6227485 0.2797347 0.7434984  
Day\_7-Day\_1 -1.1817503 -1.6329919 -0.7305087 0.0000000  
Day\_5-Day\_3 -0.9593455 -1.4105871 -0.5081039 0.0000049  
Day\_7-Day\_3 -1.9695889 -2.4208305 -1.5183474 0.0000000  
Day\_7-Day\_5 -1.0102434 -1.4614850 -0.5590018 0.0000017  
  
$TB  
 diff lwr upr p adj  
y-n 1.079872 0.8388136 1.32093 0  
  
$water\_treatment  
 diff lwr upr p adj  
PW-MO-sterile-water 0.340284 -0.01483837 0.6954063 0.0629087  
PW+MO-sterile-water -3.600293 -3.95541555 -3.2451709 0.0000000  
PW+MO-PW-MO -3.940577 -4.29569952 -3.5854549 0.0000000  
  
$`day:TB`  
 diff lwr upr p adj  
Day\_3:n-Day\_1:n -0.31984147 -1.07954248 0.43985955 0.8811923  
Day\_5:n-Day\_1:n -0.89827967 -1.65798069 -0.13857865 0.0104952  
Day\_7:n-Day\_1:n -1.64257839 -2.40227940 -0.88287737 0.0000003  
Day\_1:y-Day\_1:n -0.06776878 -0.82746980 0.69193223 0.9999917  
Day\_3:y-Day\_1:n 1.82774990 1.06804888 2.58745091 0.0000000  
Day\_5:y-Day\_1:n 0.48749705 -0.27220396 1.24719807 0.4714340  
Day\_7:y-Day\_1:n -0.78869107 -1.54839209 -0.02899005 0.0367370  
Day\_5:n-Day\_3:n -0.57843820 -1.33813922 0.18126282 0.2589734  
Day\_7:n-Day\_3:n -1.32273692 -2.08243794 -0.56303590 0.0000356  
Day\_1:y-Day\_3:n 0.25207268 -0.50762833 1.01177370 0.9635870  
Day\_3:y-Day\_3:n 2.14759136 1.38789035 2.90729238 0.0000000  
Day\_5:y-Day\_3:n 0.80733852 0.04763750 1.56703954 0.0299644  
Day\_7:y-Day\_3:n -0.46884960 -1.22855062 0.29085141 0.5214920  
Day\_7:n-Day\_5:n -0.74429872 -1.50399974 0.01540230 0.0586353  
Day\_1:y-Day\_5:n 0.83051089 0.07080987 1.59021190 0.0231296  
Day\_3:y-Day\_5:n 2.72602956 1.96632855 3.48573058 0.0000000  
Day\_5:y-Day\_5:n 1.38577672 0.62607571 2.14547774 0.0000144  
Day\_7:y-Day\_5:n 0.10958860 -0.65011242 0.86928962 0.9997851  
Day\_1:y-Day\_7:n 1.57480960 0.81510859 2.33451062 0.0000009  
Day\_3:y-Day\_7:n 3.47032828 2.71062727 4.23002930 0.0000000  
Day\_5:y-Day\_7:n 2.13007544 1.37037442 2.88977646 0.0000000  
Day\_7:y-Day\_7:n 0.85388732 0.09418630 1.61358833 0.0177057  
Day\_3:y-Day\_1:y 1.89551868 1.13581766 2.65521970 0.0000000  
Day\_5:y-Day\_1:y 0.55526584 -0.20443518 1.31496685 0.3066017  
Day\_7:y-Day\_1:y -0.72092229 -1.48062330 0.03877873 0.0742107  
Day\_5:y-Day\_3:y -1.34025284 -2.09995386 -0.58055182 0.0000277  
Day\_7:y-Day\_3:y -2.61644097 -3.37614198 -1.85673995 0.0000000  
Day\_7:y-Day\_5:y -1.27618812 -2.03588914 -0.51648711 0.0000691  
  
$`day:water\_treatment`  
 diff lwr upr  
Day\_3:sterile-water-Day\_1:sterile-water 1.56409952 0.55570514 2.572493908  
Day\_5:sterile-water-Day\_1:sterile-water -0.13666277 -1.14505716 0.871731612  
Day\_7:sterile-water-Day\_1:sterile-water -1.00670881 -2.01510319 0.001685579  
Day\_1:PW-MO-Day\_1:sterile-water -0.73277523 -1.74116961 0.275619158  
Day\_3:PW-MO-Day\_1:sterile-water 1.74122159 0.73282720 2.749615972  
Day\_5:PW-MO-Day\_1:sterile-water 0.86539619 -0.14299819 1.873790576  
Day\_7:PW-MO-Day\_1:sterile-water -0.09197876 -1.10037314 0.916415625  
Day\_1:PW+MO-Day\_1:sterile-water -1.78762409 -2.79601848 -0.779229708  
Day\_3:PW+MO-Day\_1:sterile-water -3.46220461 -4.47059900 -2.453810227  
Day\_5:PW+MO-Day\_1:sterile-water -3.76365348 -4.77204787 -2.755259100  
Day\_7:PW+MO-Day\_1:sterile-water -4.96696276 -5.97535715 -3.958568379  
Day\_5:sterile-water-Day\_3:sterile-water -1.70076230 -2.70915668 -0.692367913  
Day\_7:sterile-water-Day\_3:sterile-water -2.57080833 -3.57920271 -1.562413946  
Day\_1:PW-MO-Day\_3:sterile-water -2.29687475 -3.30526913 -1.288480366  
Day\_3:PW-MO-Day\_3:sterile-water 0.17712206 -0.83127232 1.185516448  
Day\_5:PW-MO-Day\_3:sterile-water -0.69870333 -1.70709772 0.309691052  
Day\_7:PW-MO-Day\_3:sterile-water -1.65607828 -2.66447267 -0.647683900  
Day\_1:PW+MO-Day\_3:sterile-water -3.35172362 -4.36011800 -2.343329232  
Day\_3:PW+MO-Day\_3:sterile-water -5.02630414 -6.03469852 -4.017909751  
Day\_5:PW+MO-Day\_3:sterile-water -5.32775301 -6.33614739 -4.319358624  
Day\_7:PW+MO-Day\_3:sterile-water -6.53106229 -7.53945667 -5.522667903  
Day\_7:sterile-water-Day\_5:sterile-water -0.87004603 -1.87844042 0.138348351  
Day\_1:PW-MO-Day\_5:sterile-water -0.59611245 -1.60450684 0.412281930  
Day\_3:PW-MO-Day\_5:sterile-water 1.87788436 0.86948998 2.886278745  
Day\_5:PW-MO-Day\_5:sterile-water 1.00205896 -0.00633542 2.010453348  
Day\_7:PW-MO-Day\_5:sterile-water 0.04468401 -0.96371037 1.053078397  
Day\_1:PW+MO-Day\_5:sterile-water -1.65096132 -2.65935570 -0.642566935  
Day\_3:PW+MO-Day\_5:sterile-water -3.32554184 -4.33393622 -2.317147455  
Day\_5:PW+MO-Day\_5:sterile-water -3.62699071 -4.63538510 -2.618596327  
Day\_7:PW+MO-Day\_5:sterile-water -4.83029999 -5.83869437 -3.821905606  
Day\_1:PW-MO-Day\_7:sterile-water 0.27393358 -0.73446080 1.282327963  
Day\_3:PW-MO-Day\_7:sterile-water 2.74793039 1.73953601 3.756324778  
Day\_5:PW-MO-Day\_7:sterile-water 1.87210500 0.86371061 2.880499381  
Day\_7:PW-MO-Day\_7:sterile-water 0.91473005 -0.09366434 1.923124430  
Day\_1:PW+MO-Day\_7:sterile-water -0.78091529 -1.78930967 0.227479098  
Day\_3:PW+MO-Day\_7:sterile-water -2.45549581 -3.46389019 -1.447101422  
Day\_5:PW+MO-Day\_7:sterile-water -2.75694468 -3.76533906 -1.748550294  
Day\_7:PW+MO-Day\_7:sterile-water -3.96025396 -4.96864834 -2.951859573  
Day\_3:PW-MO-Day\_1:PW-MO 2.47399681 1.46560243 3.482391198  
Day\_5:PW-MO-Day\_1:PW-MO 1.59817142 0.58977703 2.606565802  
Day\_7:PW-MO-Day\_1:PW-MO 0.64079647 -0.36759792 1.649190851  
Day\_1:PW+MO-Day\_1:PW-MO -1.05484887 -2.06324325 -0.046454482  
Day\_3:PW+MO-Day\_1:PW-MO -2.72942939 -3.73782377 -1.721035001  
Day\_5:PW+MO-Day\_1:PW-MO -3.03087826 -4.03927264 -2.022483874  
Day\_7:PW+MO-Day\_1:PW-MO -4.23418754 -5.24258192 -3.225793153  
Day\_5:PW-MO-Day\_3:PW-MO -0.87582540 -1.88421978 0.132568987  
Day\_7:PW-MO-Day\_3:PW-MO -1.83320035 -2.84159473 -0.824805964  
Day\_1:PW+MO-Day\_3:PW-MO -3.52884568 -4.53724006 -2.520451296  
Day\_3:PW+MO-Day\_3:PW-MO -5.20342620 -6.21182058 -4.195031816  
Day\_5:PW+MO-Day\_3:PW-MO -5.50487507 -6.51326946 -4.496480688  
Day\_7:PW+MO-Day\_3:PW-MO -6.70818435 -7.71657874 -5.699789967  
Day\_7:PW-MO-Day\_5:PW-MO -0.95737495 -1.96576934 0.051019433  
Day\_1:PW+MO-Day\_5:PW-MO -2.65302028 -3.66141467 -1.644625900  
Day\_3:PW+MO-Day\_5:PW-MO -4.32760080 -5.33599519 -3.319206419  
Day\_5:PW+MO-Day\_5:PW-MO -4.62904968 -5.63744406 -3.620655292  
Day\_7:PW+MO-Day\_5:PW-MO -5.83235895 -6.84075334 -4.823964571  
Day\_1:PW+MO-Day\_7:PW-MO -1.69564533 -2.70403972 -0.687250948  
Day\_3:PW+MO-Day\_7:PW-MO -3.37022585 -4.37862024 -2.361831468  
Day\_5:PW+MO-Day\_7:PW-MO -3.67167472 -4.68006911 -2.663280340  
Day\_7:PW+MO-Day\_7:PW-MO -4.87498400 -5.88337839 -3.866589619  
Day\_3:PW+MO-Day\_1:PW+MO -1.67458052 -2.68297490 -0.666186136  
Day\_5:PW+MO-Day\_1:PW+MO -1.97602939 -2.98442378 -0.967635008  
Day\_7:PW+MO-Day\_1:PW+MO -3.17933867 -4.18773306 -2.170944287  
Day\_5:PW+MO-Day\_3:PW+MO -0.30144887 -1.30984326 0.706945511  
Day\_7:PW+MO-Day\_3:PW+MO -1.50475815 -2.51315254 -0.496363768  
Day\_7:PW+MO-Day\_5:PW+MO -1.20330928 -2.21170366 -0.194914895  
 p adj  
Day\_3:sterile-water-Day\_1:sterile-water 0.0001540  
Day\_5:sterile-water-Day\_1:sterile-water 0.9999983  
Day\_7:sterile-water-Day\_1:sterile-water 0.0507394  
Day\_1:PW-MO-Day\_1:sterile-water 0.3673389  
Day\_3:PW-MO-Day\_1:sterile-water 0.0000195  
Day\_5:PW-MO-Day\_1:sterile-water 0.1573217  
Day\_7:PW-MO-Day\_1:sterile-water 1.0000000  
Day\_1:PW+MO-Day\_1:sterile-water 0.0000113  
Day\_3:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_5:sterile-water-Day\_3:sterile-water 0.0000315  
Day\_7:sterile-water-Day\_3:sterile-water 0.0000000  
Day\_1:PW-MO-Day\_3:sterile-water 0.0000000  
Day\_3:PW-MO-Day\_3:sterile-water 0.9999751  
Day\_5:PW-MO-Day\_3:sterile-water 0.4388765  
Day\_7:PW-MO-Day\_3:sterile-water 0.0000531  
Day\_1:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_3:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_7:sterile-water-Day\_5:sterile-water 0.1520910  
Day\_1:PW-MO-Day\_5:sterile-water 0.6716810  
Day\_3:PW-MO-Day\_5:sterile-water 0.0000039  
Day\_5:PW-MO-Day\_5:sterile-water 0.0528293  
Day\_7:PW-MO-Day\_5:sterile-water 1.0000000  
Day\_1:PW+MO-Day\_5:sterile-water 0.0000563  
Day\_3:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_1:PW-MO-Day\_7:sterile-water 0.9983727  
Day\_3:PW-MO-Day\_7:sterile-water 0.0000000  
Day\_5:PW-MO-Day\_7:sterile-water 0.0000041  
Day\_7:PW-MO-Day\_7:sterile-water 0.1085209  
Day\_1:PW+MO-Day\_7:sterile-water 0.2775082  
Day\_3:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_3:PW-MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW-MO-Day\_1:PW-MO 0.0001040  
Day\_7:PW-MO-Day\_1:PW-MO 0.5697876  
Day\_1:PW+MO-Day\_1:PW-MO 0.0330451  
Day\_3:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW-MO-Day\_3:PW-MO 0.1457799  
Day\_7:PW-MO-Day\_3:PW-MO 0.0000066  
Day\_1:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_7:PW-MO-Day\_5:PW-MO 0.0770752  
Day\_1:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_1:PW+MO-Day\_7:PW-MO 0.0000334  
Day\_3:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_1:PW+MO 0.0000428  
Day\_5:PW+MO-Day\_1:PW+MO 0.0000012  
Day\_7:PW+MO-Day\_1:PW+MO 0.0000000  
Day\_5:PW+MO-Day\_3:PW+MO 0.9962387  
Day\_7:PW+MO-Day\_3:PW+MO 0.0003034  
Day\_7:PW+MO-Day\_5:PW+MO 0.0078960  
  
$`TB:water\_treatment`  
 diff lwr upr p adj  
y:sterile-water-n:sterile-water 1.0008405 0.3845328 1.6171483 0.0002063  
n:PW-MO-n:sterile-water 0.2793426 -0.3369651 0.8956503 0.7585152  
y:PW-MO-n:sterile-water 1.4020658 0.7857581 2.0183736 0.0000003  
n:PW+MO-n:sterile-water -3.6578986 -4.2742063 -3.0415908 0.0000000  
y:PW+MO-n:sterile-water -2.5418473 -3.1581551 -1.9255396 0.0000000  
n:PW-MO-y:sterile-water -0.7214979 -1.3378056 -0.1051902 0.0131854  
y:PW-MO-y:sterile-water 0.4012253 -0.2150824 1.0175330 0.3958413  
n:PW+MO-y:sterile-water -4.6587391 -5.2750468 -4.0424314 0.0000000  
y:PW+MO-y:sterile-water -3.5426879 -4.1589956 -2.9263802 0.0000000  
y:PW-MO-n:PW-MO 1.1227232 0.5064155 1.7390309 0.0000284  
n:PW+MO-n:PW-MO -3.9372412 -4.5535489 -3.3209335 0.0000000  
y:PW+MO-n:PW-MO -2.8211900 -3.4374977 -2.2048822 0.0000000  
n:PW+MO-y:PW-MO -5.0599644 -5.6762721 -4.4436567 0.0000000  
y:PW+MO-y:PW-MO -3.9439132 -4.5602209 -3.3276055 0.0000000  
y:PW+MO-n:PW+MO 1.1160512 0.4997435 1.7323589 0.0000317  
  
$`day:TB:water\_treatment`  
 diff lwr upr  
Day\_3:n:sterile-water-Day\_1:n:sterile-water 0.12748302 -1.47333045 1.72829649  
Day\_5:n:sterile-water-Day\_1:n:sterile-water -0.95922474 -2.56003820 0.64158873  
Day\_7:n:sterile-water-Day\_1:n:sterile-water -1.49396778 -3.09478124 0.10684569  
Day\_1:y:sterile-water-Day\_1:n:sterile-water -0.37237819 -1.97319165 1.22843528  
Day\_3:y:sterile-water-Day\_1:n:sterile-water 2.62833784 1.02752437 4.22915131  
Day\_5:y:sterile-water-Day\_1:n:sterile-water 0.31352101 -1.28729246 1.91433447  
Day\_7:y:sterile-water-Day\_1:n:sterile-water -0.89182802 -2.49264149 0.70898545  
Day\_1:n:PW-MO-Day\_1:n:sterile-water 0.23735219 -1.36346128 1.83816566  
Day\_3:n:PW-MO-Day\_1:n:sterile-water 0.22486268 -1.37595078 1.82567615  
Day\_5:n:PW-MO-Day\_1:n:sterile-water -0.28368820 -1.88450167 1.31712526  
Day\_7:n:PW-MO-Day\_1:n:sterile-water -1.38686565 -2.98767912 0.21394782  
Day\_1:y:PW-MO-Day\_1:n:sterile-water -2.07528082 -3.67609429 -0.47446736  
Day\_3:y:PW-MO-Day\_1:n:sterile-water 2.88520231 1.28438884 4.48601578  
Day\_5:y:PW-MO-Day\_1:n:sterile-water 1.64210240 0.04128893 3.24291587  
Day\_7:y:PW-MO-Day\_1:n:sterile-water 0.83052995 -0.77028352 2.43134342  
Day\_1:n:PW+MO-Day\_1:n:sterile-water -3.21466561 -4.81547908 -1.61385214  
Day\_3:n:PW+MO-Day\_1:n:sterile-water -4.28918353 -5.88999699 -2.68837006  
Day\_5:n:PW+MO-Day\_1:n:sterile-water -4.42923949 -6.03005295 -2.82842602  
Day\_7:n:PW+MO-Day\_1:n:sterile-water -5.02421515 -6.62502862 -3.42340168  
Day\_1:y:PW+MO-Day\_1:n:sterile-water -0.73296076 -2.33377423 0.86785271  
Day\_3:y:PW+MO-Day\_1:n:sterile-water -3.00760388 -4.60841735 -1.40679041  
Day\_5:y:PW+MO-Day\_1:n:sterile-water -3.47044567 -5.07125913 -1.86963220  
Day\_7:y:PW+MO-Day\_1:n:sterile-water -5.28208856 -6.88290203 -3.68127509  
Day\_5:n:sterile-water-Day\_3:n:sterile-water -1.08670776 -2.68752123 0.51410571  
Day\_7:n:sterile-water-Day\_3:n:sterile-water -1.62145080 -3.22226426 -0.02063733  
Day\_1:y:sterile-water-Day\_3:n:sterile-water -0.49986121 -2.10067467 1.10095226  
Day\_3:y:sterile-water-Day\_3:n:sterile-water 2.50085482 0.90004135 4.10166829  
Day\_5:y:sterile-water-Day\_3:n:sterile-water 0.18603799 -1.41477548 1.78685145  
Day\_7:y:sterile-water-Day\_3:n:sterile-water -1.01931104 -2.62012451 0.58150243  
Day\_1:n:PW-MO-Day\_3:n:sterile-water 0.10986917 -1.49094430 1.71068263  
Day\_3:n:PW-MO-Day\_3:n:sterile-water 0.09737966 -1.50343381 1.69819313  
Day\_5:n:PW-MO-Day\_3:n:sterile-water -0.41117123 -2.01198469 1.18964224  
Day\_7:n:PW-MO-Day\_3:n:sterile-water -1.51434867 -3.11516214 0.08646479  
Day\_1:y:PW-MO-Day\_3:n:sterile-water -2.20276385 -3.80357731 -0.60195038  
Day\_3:y:PW-MO-Day\_3:n:sterile-water 2.75771929 1.15690582 4.35853275  
Day\_5:y:PW-MO-Day\_3:n:sterile-water 1.51461938 -0.08619409 3.11543285  
Day\_7:y:PW-MO-Day\_3:n:sterile-water 0.70304693 -0.89776654 2.30386040  
Day\_1:n:PW+MO-Day\_3:n:sterile-water -3.34214863 -4.94296210 -1.74133516  
Day\_3:n:PW+MO-Day\_3:n:sterile-water -4.41666655 -6.01748001 -2.81585308  
Day\_5:n:PW+MO-Day\_3:n:sterile-water -4.55672251 -6.15753597 -2.95590904  
Day\_7:n:PW+MO-Day\_3:n:sterile-water -5.15169817 -6.75251164 -3.55088470  
Day\_1:y:PW+MO-Day\_3:n:sterile-water -0.86044378 -2.46125725 0.74036969  
Day\_3:y:PW+MO-Day\_3:n:sterile-water -3.13508690 -4.73590037 -1.53427344  
Day\_5:y:PW+MO-Day\_3:n:sterile-water -3.59792869 -5.19874216 -1.99711522  
Day\_7:y:PW+MO-Day\_3:n:sterile-water -5.40957158 -7.01038505 -3.80875811  
Day\_7:n:sterile-water-Day\_5:n:sterile-water -0.53474304 -2.13555651 1.06607043  
Day\_1:y:sterile-water-Day\_5:n:sterile-water 0.58684655 -1.01396692 2.18766002  
Day\_3:y:sterile-water-Day\_5:n:sterile-water 3.58756258 1.98674911 5.18837605  
Day\_5:y:sterile-water-Day\_5:n:sterile-water 1.27274574 -0.32806772 2.87355921  
Day\_7:y:sterile-water-Day\_5:n:sterile-water 0.06739672 -1.53341675 1.66821018  
Day\_1:n:PW-MO-Day\_5:n:sterile-water 1.19657692 -0.40423654 2.79739039  
Day\_3:n:PW-MO-Day\_5:n:sterile-water 1.18408742 -0.41672605 2.78490089  
Day\_5:n:PW-MO-Day\_5:n:sterile-water 0.67553653 -0.92527694 2.27635000  
Day\_7:n:PW-MO-Day\_5:n:sterile-water -0.42764092 -2.02845438 1.17317255  
Day\_1:y:PW-MO-Day\_5:n:sterile-water -1.11605609 -2.71686956 0.48475738  
Day\_3:y:PW-MO-Day\_5:n:sterile-water 3.84442704 2.24361358 5.44524051  
Day\_5:y:PW-MO-Day\_5:n:sterile-water 2.60132714 1.00051367 4.20214061  
Day\_7:y:PW-MO-Day\_5:n:sterile-water 1.78975469 0.18894122 3.39056815  
Day\_1:n:PW+MO-Day\_5:n:sterile-water -2.25544087 -3.85625434 -0.65462740  
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Day\_7:n:PW+MO-Day\_3:n:PW+MO -0.73503163 -2.33584509 0.86578184  
Day\_1:y:PW+MO-Day\_3:n:PW+MO 3.55622277 1.95540930 5.15703623  
Day\_3:y:PW+MO-Day\_3:n:PW+MO 1.28157964 -0.31923382 2.88239311  
Day\_5:y:PW+MO-Day\_3:n:PW+MO 0.81873786 -0.78207561 2.41955133  
Day\_7:y:PW+MO-Day\_3:n:PW+MO -0.99290503 -2.59371850 0.60790843  
Day\_7:n:PW+MO-Day\_5:n:PW+MO -0.59497567 -2.19578913 1.00583780  
Day\_1:y:PW+MO-Day\_5:n:PW+MO 3.69627873 2.09546526 5.29709219  
Day\_3:y:PW+MO-Day\_5:n:PW+MO 1.42163560 -0.17917786 3.02244907  
Day\_5:y:PW+MO-Day\_5:n:PW+MO 0.95879382 -0.64201965 2.55960729  
Day\_7:y:PW+MO-Day\_5:n:PW+MO -0.85284907 -2.45366254 0.74796439  
Day\_1:y:PW+MO-Day\_7:n:PW+MO 4.29125439 2.69044092 5.89206786  
Day\_3:y:PW+MO-Day\_7:n:PW+MO 2.01661127 0.41579780 3.61742474  
Day\_5:y:PW+MO-Day\_7:n:PW+MO 1.55376948 -0.04704398 3.15458295  
Day\_7:y:PW+MO-Day\_7:n:PW+MO -0.25787341 -1.85868688 1.34294006  
Day\_3:y:PW+MO-Day\_1:y:PW+MO -2.27464312 -3.87545659 -0.67382965  
Day\_5:y:PW+MO-Day\_1:y:PW+MO -2.73748491 -4.33829837 -1.13667144  
Day\_7:y:PW+MO-Day\_1:y:PW+MO -4.54912780 -6.14994127 -2.94831433  
Day\_5:y:PW+MO-Day\_3:y:PW+MO -0.46284179 -2.06365525 1.13797168  
Day\_7:y:PW+MO-Day\_3:y:PW+MO -2.27448468 -3.87529815 -0.67367121  
Day\_7:y:PW+MO-Day\_5:y:PW+MO -1.81164289 -3.41245636 -0.21082942  
 p adj  
Day\_3:n:sterile-water-Day\_1:n:sterile-water 1.0000000  
Day\_5:n:sterile-water-Day\_1:n:sterile-water 0.7919930  
Day\_7:n:sterile-water-Day\_1:n:sterile-water 0.0956261  
Day\_1:y:sterile-water-Day\_1:n:sterile-water 0.9999993  
Day\_3:y:sterile-water-Day\_1:n:sterile-water 0.0000192  
Day\_5:y:sterile-water-Day\_1:n:sterile-water 1.0000000  
Day\_7:y:sterile-water-Day\_1:n:sterile-water 0.8753436  
Day\_1:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_7:n:PW-MO-Day\_1:n:sterile-water 0.1723490  
Day\_1:y:PW-MO-Day\_1:n:sterile-water 0.0016944  
Day\_3:y:PW-MO-Day\_1:n:sterile-water 0.0000022  
Day\_5:y:PW-MO-Day\_1:n:sterile-water 0.0383727  
Day\_7:y:PW-MO-Day\_1:n:sterile-water 0.9304923  
Day\_1:n:PW+MO-Day\_1:n:sterile-water 0.0000001  
Day\_3:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_1:n:sterile-water 0.9795458  
Day\_3:y:PW+MO-Day\_1:n:sterile-water 0.0000008  
Day\_5:y:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_5:n:sterile-water-Day\_3:n:sterile-water 0.5893047  
Day\_7:n:sterile-water-Day\_3:n:sterile-water 0.0438443  
Day\_1:y:sterile-water-Day\_3:n:sterile-water 0.9998839  
Day\_3:y:sterile-water-Day\_3:n:sterile-water 0.0000552  
Day\_5:y:sterile-water-Day\_3:n:sterile-water 1.0000000  
Day\_7:y:sterile-water-Day\_3:n:sterile-water 0.7013754  
Day\_1:n:PW-MO-Day\_3:n:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_3:n:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_3:n:sterile-water 0.9999958  
Day\_7:n:PW-MO-Day\_3:n:sterile-water 0.0848700  
Day\_1:y:PW-MO-Day\_3:n:sterile-water 0.0006225  
Day\_3:y:PW-MO-Day\_3:n:sterile-water 0.0000065  
Day\_5:y:PW-MO-Day\_3:n:sterile-water 0.0847344  
Day\_7:y:PW-MO-Day\_3:n:sterile-water 0.9871203  
Day\_1:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_3:n:sterile-water 0.9061180  
Day\_3:y:PW+MO-Day\_3:n:sterile-water 0.0000003  
Day\_5:y:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:n:sterile-water-Day\_5:n:sterile-water 0.9996681  
Day\_1:y:sterile-water-Day\_5:n:sterile-water 0.9987106  
Day\_3:y:sterile-water-Day\_5:n:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_5:n:sterile-water 0.2981239  
Day\_7:y:sterile-water-Day\_5:n:sterile-water 1.0000000  
Day\_1:n:PW-MO-Day\_5:n:sterile-water 0.4077348  
Day\_3:n:PW-MO-Day\_5:n:sterile-water 0.4273429  
Day\_5:n:PW-MO-Day\_5:n:sterile-water 0.9919330  
Day\_7:n:PW-MO-Day\_5:n:sterile-water 0.9999915  
Day\_1:y:PW-MO-Day\_5:n:sterile-water 0.5394993  
Day\_3:y:PW-MO-Day\_5:n:sterile-water 0.0000000  
Day\_5:y:PW-MO-Day\_5:n:sterile-water 0.0000240  
Day\_7:y:PW-MO-Day\_5:n:sterile-water 0.0141042  
Day\_1:n:PW+MO-Day\_5:n:sterile-water 0.0004086  
Day\_3:n:PW+MO-Day\_5:n:sterile-water 0.0000001  
Day\_5:n:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_5:n:sterile-water 1.0000000  
Day\_3:y:PW+MO-Day\_5:n:sterile-water 0.0020854  
Day\_5:y:PW+MO-Day\_5:n:sterile-water 0.0000507  
Day\_7:y:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_1:y:sterile-water-Day\_7:n:sterile-water 0.5301471  
Day\_3:y:sterile-water-Day\_7:n:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_7:n:sterile-water 0.0124434  
Day\_7:y:sterile-water-Day\_7:n:sterile-water 0.9981598  
Day\_1:n:PW-MO-Day\_7:n:sterile-water 0.0211573  
Day\_3:n:PW-MO-Day\_7:n:sterile-water 0.0230377  
Day\_5:n:PW-MO-Day\_7:n:sterile-water 0.3866947  
Day\_7:n:PW-MO-Day\_7:n:sterile-water 1.0000000  
Day\_1:y:PW-MO-Day\_7:n:sterile-water 0.9988714  
Day\_3:y:PW-MO-Day\_7:n:sterile-water 0.0000000  
Day\_5:y:PW-MO-Day\_7:n:sterile-water 0.0000003  
Day\_7:y:PW-MO-Day\_7:n:sterile-water 0.0002341  
Day\_1:n:PW+MO-Day\_7:n:sterile-water 0.0227471  
Day\_3:n:PW+MO-Day\_7:n:sterile-water 0.0000048  
Day\_5:n:PW+MO-Day\_7:n:sterile-water 0.0000015  
Day\_7:n:PW+MO-Day\_7:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_7:n:sterile-water 0.9696777  
Day\_3:y:PW+MO-Day\_7:n:sterile-water 0.0852279  
Day\_5:y:PW+MO-Day\_7:n:sterile-water 0.0036067  
Day\_7:y:PW+MO-Day\_7:n:sterile-water 0.0000000  
Day\_3:y:sterile-water-Day\_1:y:sterile-water 0.0000008  
Day\_5:y:sterile-water-Day\_1:y:sterile-water 0.9903299  
Day\_7:y:sterile-water-Day\_1:y:sterile-water 0.9997874  
Day\_1:n:PW-MO-Day\_1:y:sterile-water 0.9978188  
Day\_3:n:PW-MO-Day\_1:y:sterile-water 0.9983547  
Day\_5:n:PW-MO-Day\_1:y:sterile-water 1.0000000  
Day\_7:n:PW-MO-Day\_1:y:sterile-water 0.7090765  
Day\_1:y:PW-MO-Day\_1:y:sterile-water 0.0256590  
Day\_3:y:PW-MO-Day\_1:y:sterile-water 0.0000001  
Day\_5:y:PW-MO-Day\_1:y:sterile-water 0.0027036  
Day\_7:y:PW-MO-Day\_1:y:sterile-water 0.3979493  
Day\_1:n:PW+MO-Day\_1:y:sterile-water 0.0000032  
Day\_3:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_1:y:sterile-water 0.9999996  
Day\_3:y:PW+MO-Day\_1:y:sterile-water 0.0000181  
Day\_5:y:PW+MO-Day\_1:y:sterile-water 0.0000004  
Day\_7:y:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_3:y:sterile-water 0.0002532  
Day\_7:y:sterile-water-Day\_3:y:sterile-water 0.0000000  
Day\_1:n:PW-MO-Day\_3:y:sterile-water 0.0001362  
Day\_3:n:PW-MO-Day\_3:y:sterile-water 0.0001230  
Day\_5:n:PW-MO-Day\_3:y:sterile-water 0.0000018  
Day\_7:n:PW-MO-Day\_3:y:sterile-water 0.0000000  
Day\_1:y:PW-MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:y:PW-MO-Day\_3:y:sterile-water 1.0000000  
Day\_5:y:PW-MO-Day\_3:y:sterile-water 0.7528131  
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Day\_1:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_5:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:y:sterile-water-Day\_5:y:sterile-water 0.3942057  
Day\_1:n:PW-MO-Day\_5:y:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_5:y:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_5:y:sterile-water 0.9983559  
Day\_7:n:PW-MO-Day\_5:y:sterile-water 0.0260973  
Day\_1:y:PW-MO-Day\_5:y:sterile-water 0.0001387  
Day\_3:y:PW-MO-Day\_5:y:sterile-water 0.0000307  
Day\_5:y:PW-MO-Day\_5:y:sterile-water 0.2305634  
Day\_7:y:PW-MO-Day\_5:y:sterile-water 0.9998024  
Day\_1:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
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Day\_3:y:PW+MO-Day\_5:y:sterile-water 0.0000001  
Day\_5:y:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_5:y:sterile-water 0.0000000  
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Day\_3:n:PW-MO-Day\_7:y:sterile-water 0.5384257  
Day\_5:n:PW-MO-Day\_7:y:sterile-water 0.9978944  
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Day\_3:y:PW-MO-Day\_7:y:sterile-water 0.0000000  
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Day\_1:y:PW-MO-Day\_1:n:PW-MO 0.0002577  
Day\_3:y:PW-MO-Day\_1:n:PW-MO 0.0000163  
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Day\_7:y:PW-MO-Day\_1:n:PW-MO 0.9985027  
Day\_1:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
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Day\_5:y:PW+MO-Day\_1:n:PW-MO 0.0000000  
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Day\_3:y:PW-MO-Day\_3:n:PW-MO 0.0000147  
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Day\_5:n:PW+MO-Day\_3:n:PW-MO 0.0000000  
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Day\_1:y:PW+MO-Day\_3:n:PW-MO 0.7939449  
Day\_3:y:PW+MO-Day\_3:n:PW-MO 0.0000001  
Day\_5:y:PW+MO-Day\_3:n:PW-MO 0.0000000  
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Day\_7:n:PW-MO-Day\_5:n:PW-MO 0.5613329  
Day\_1:y:PW-MO-Day\_5:n:PW-MO 0.0139229  
Day\_3:y:PW-MO-Day\_5:n:PW-MO 0.0000002  
Day\_5:y:PW-MO-Day\_5:n:PW-MO 0.0052700  
Day\_7:y:PW-MO-Day\_5:n:PW-MO 0.5426102  
Day\_1:n:PW+MO-Day\_5:n:PW-MO 0.0000015  
Day\_3:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
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Day\_3:y:PW+MO-Day\_5:n:PW-MO 0.0000086  
Day\_5:y:PW+MO-Day\_5:n:PW-MO 0.0000002  
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Day\_3:y:PW-MO-Day\_7:n:PW-MO 0.0000000  
Day\_5:y:PW-MO-Day\_7:n:PW-MO 0.0000007  
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Day\_1:n:PW+MO-Day\_7:n:PW-MO 0.0107673  
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Day\_5:y:PW+MO-Day\_7:n:PW-MO 0.0015888  
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Day\_5:n:PW+MO-Day\_1:y:PW-MO 0.0001843  
Day\_7:n:PW+MO-Day\_1:y:PW-MO 0.0000013  
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Day\_3:y:PW+MO-Day\_1:y:PW-MO 0.8279277  
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Day\_7:y:PW+MO-Day\_1:y:PW-MO 0.0000002  
Day\_5:y:PW-MO-Day\_3:y:PW-MO 0.3385588  
Day\_7:y:PW-MO-Day\_3:y:PW-MO 0.0019868  
Day\_1:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
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Day\_7:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
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Day\_7:y:PW+MO-Day\_3:y:PW-MO 0.0000000  
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Day\_5:y:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_1:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_7:y:PW-MO 0.0631035  
Day\_3:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_5:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_1:n:PW+MO 0.6099665  
Day\_5:n:PW+MO-Day\_1:n:PW+MO 0.3802096  
Day\_7:n:PW+MO-Day\_1:n:PW+MO 0.0122628  
Day\_1:y:PW+MO-Day\_1:n:PW+MO 0.0000647  
Day\_3:y:PW+MO-Day\_1:n:PW+MO 1.0000000  
Day\_5:y:PW+MO-Day\_1:n:PW+MO 1.0000000  
Day\_7:y:PW+MO-Day\_1:n:PW+MO 0.0018006  
Day\_5:n:PW+MO-Day\_3:n:PW+MO 1.0000000  
Day\_7:n:PW+MO-Day\_3:n:PW+MO 0.9789155  
Day\_1:y:PW+MO-Day\_3:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_3:n:PW+MO 0.2866730  
Day\_5:y:PW+MO-Day\_3:n:PW+MO 0.9387984  
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Day\_7:n:PW+MO-Day\_5:n:PW+MO 0.9984387  
Day\_1:y:PW+MO-Day\_5:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_5:n:PW+MO 0.1433988  
Day\_5:y:PW+MO-Day\_5:n:PW+MO 0.7925941  
Day\_7:y:PW+MO-Day\_5:n:PW+MO 0.9127621  
Day\_1:y:PW+MO-Day\_7:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_7:n:PW+MO 0.0026601  
Day\_5:y:PW+MO-Day\_7:n:PW+MO 0.0669760  
Day\_7:y:PW+MO-Day\_7:n:PW+MO 1.0000000  
Day\_3:y:PW+MO-Day\_1:y:PW+MO 0.0003502  
Day\_5:y:PW+MO-Day\_1:y:PW+MO 0.0000077  
Day\_7:y:PW+MO-Day\_1:y:PW+MO 0.0000000  
Day\_5:y:PW+MO-Day\_3:y:PW+MO 0.9999671  
Day\_7:y:PW+MO-Day\_3:y:PW+MO 0.0003506  
Day\_7:y:PW+MO-Day\_5:y:PW+MO 0.0120819

# emmeans and cld  
  
# Compute CLD letters for 'day'  
cld\_day <- emmeans(aov\_2b, pairwise ~ day, adjust = "tukey") %>%  
 cld(Letters = letters, reverse = TRUE)

NOTE: Results may be misleading due to involvement in interactions

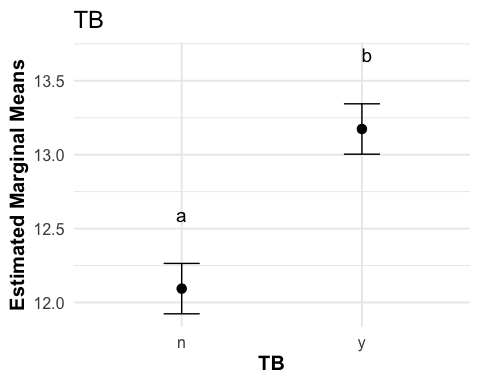
cld\_day\_2b <- ggplot(cld\_day, aes(x = day, y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 5, color = "black") + # Add CLD letters  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("Day") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Adjust text size for better readability  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_day\_2b



# Compute CLD letters for 'TB'  
cld\_TB <- emmeans(aov\_2b, pairwise ~ TB, adjust = "tukey") %>%  
 cld(Letters = letters)

NOTE: Results may be misleading due to involvement in interactions

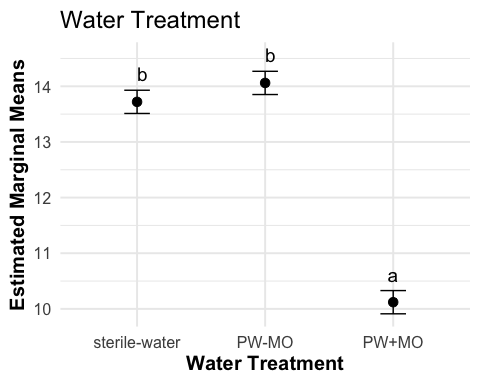
cld\_TB\_2b <- ggplot(cld\_TB, aes(x = TB, y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 5, color = "black") + # Add CLD letters  
 xlab("TB") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("TB") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Adjust text size for better readability  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_TB\_2b



# Compute CLD letters for 'water\_treatment'  
cld\_water\_treatment <- emmeans(aov\_2b, pairwise ~ water\_treatment, adjust = "tukey") %>%  
 cld(Letters = letters)

NOTE: Results may be misleading due to involvement in interactions

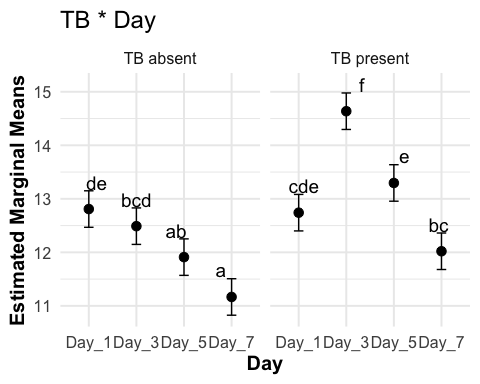
cld\_water\_treatment\_2b <-ggplot(cld\_water\_treatment, aes(x = water\_treatment, y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 5, color = "black") + # Add CLD letters  
 xlab("Water Treatment") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("Water Treatment") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Adjust text size for better readability  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_water\_treatment\_2b



# Compute CLD letters for 'TB \* day'  
cld\_day\_TB <- emmeans(aov\_2b, pairwise ~ TB \* day, adjust = "tukey") %>%  
 cld(Letters = letters)

NOTE: Results may be misleading due to involvement in interactions

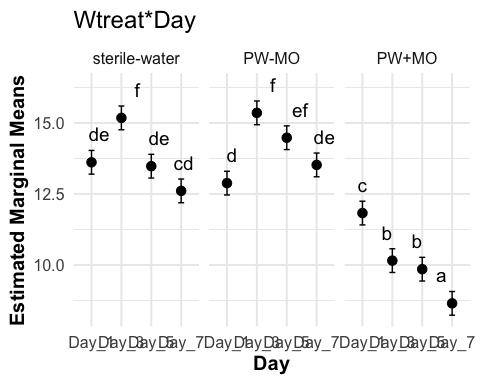
tb\_labels <- c("n" = "TB absent", "y" = "TB present")  
# Create the plot with custom labels for 'TB'  
cld\_tb\_day\_int\_2b <- ggplot(cld\_day\_TB, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 5, color = "black") + # Add CLD letters  
 facet\_wrap(~ TB, labeller = as\_labeller(tb\_labels)) + # Facet by TB with custom labels  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("TB \* Day") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Rotate x-axis labels 45 degrees  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_tb\_day\_int\_2b



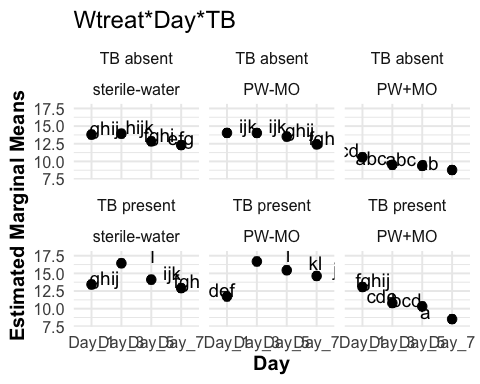
# Compute CLD letters for 'water\_treatment \* day'  
cld\_water\_treatment\_day <- emmeans(aov\_2b, pairwise ~ water\_treatment \* day, adjust = "tukey") %>%  
 cld(Letters = letters)

NOTE: Results may be misleading due to involvement in interactions

cld\_watertreat\_day\_int\_2b <- ggplot(cld\_water\_treatment\_day, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 5, color = "black") + # Add CLD letters  
 facet\_wrap(~ water\_treatment) + # Facet by water\_treatment  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("Wtreat\*Day") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Rotate x-axis labels 45 degrees  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_watertreat\_day\_int\_2b



# third order...prepare for chaos  
# Compute CLD letters for 'water\_treatment \* day'  
cld\_water\_thirdorder <- emmeans(aov\_2b, pairwise ~ water\_treatment \* day \* TB, adjust = "tukey") %>%  
 cld(Letters = letters)  
tb\_labels <- c("n" = "TB absent", "y" = "TB present")  
cld\_water\_thirdorder\_2b <- ggplot(cld\_water\_thirdorder, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 3) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 5, color = "black") + # Add CLD letters  
 facet\_wrap(TB ~ water\_treatment, labeller = labeller(TB = tb\_labels)) + # Facet by water\_treatment with custom labels for TB  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 ggtitle("Wtreat\*Day\*TB") +  
 theme\_minimal(base\_size = 15) + # Use minimal theme for clean look  
 theme(axis.text.x = element\_text(size = 12), # Rotate x-axis labels 45 degrees  
 axis.title.x = element\_text(face = "bold"),  
 axis.title.y = element\_text(face = "bold"))  
cld\_water\_thirdorder\_2b



# get the stats for each comparison  
ph\_2b\_day <- emmeans(aov\_2b, pairwise ~ day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_TB <- emmeans(aov\_2b, pairwise ~ TB, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_treatment <- emmeans(aov\_2b, pairwise ~ water\_treatment, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_day\_TB <- emmeans(aov\_2b, pairwise ~ TB \* day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_treatment\_day <- emmeans(aov\_2b, pairwise ~ water\_treatment \* day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_thirdorder <- emmeans(aov\_2b, pairwise ~ water\_treatment \* day \* TB, adjust = "tukey")$contrasts

## GLM poisson untransformed Bd ~ day\*TB\*water\_treatment

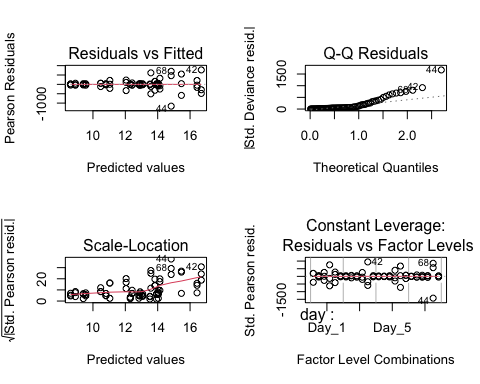
.L and .Q and .C are estimating things for model we do not need, turn it off, see the bolker thing Tatum is sending

https://stats.stackexchange.com/questions/387735/interpreting-the-estimate-of-an-ordered-factor-in-regression

pw\_noday0$adh\_plus\_sup\_rounded <- round(pw\_noday0$adh\_plus\_sup)  
  
pw\_noday0

day sample\_ID adh sup adh\_plus\_sup replicate microbes  
1 Day\_1 1%TB 1203296 131232 1334529 1 n  
2 Day\_3 1%TB 13820819 614229 14435048 1 n  
3 Day\_5 1%TB 1241691 47489 1289180 1 n  
4 Day\_7 1%TB 374678 40374 415051 1 n  
5 Day\_1 MQ 55715 1119310 1175025 1 n  
6 Day\_3 MQ 97420 989171 1086591 1 n  
7 Day\_5 MQ 50775 330455 381229 1 n  
8 Day\_7 MQ 37740 181836 219575 1 n  
9 Day\_1 1%TB+PW+microorganism 64747 395171 459917 1 y  
10 Day\_3 1%TB+PW+microorganism 4222 40438 44660 1 y  
11 Day\_5 1%TB+PW+microorganism 610 45721 46331 1 y  
12 Day\_7 1%TB+PW+microorganism 1166 6039 7205 1 y  
13 Day\_1 PW+microorganism 63742 21 63763 1 y  
14 Day\_3 PW+microorganism 16020 153 16174 1 y  
15 Day\_5 PW+microorganism 15313 783 16096 1 y  
16 Day\_7 PW+microorganism 12081 512 12593 1 y  
17 Day\_1 1%TB+PW-microorganism 26238 7160 33398 1 n  
18 Day\_3 1%TB+PW-microorganism 15461355 297759 15759114 1 n  
19 Day\_5 1%TB+PW-microorganism 4249727 1045302 5295029 1 n  
20 Day\_7 1%TB+PW-microorganism 3123961 414911 3538872 1 n  
21 Day\_1 PW-microorganism 54675 1190768 1245443 1 n  
22 Day\_3 PW-microorganism 23556 1243595 1267151 1 n  
23 Day\_5 PW-microorganism 97216 658323 755539 1 n  
24 Day\_7 PW-microorganism 34470 251379 285849 1 n  
25 Day\_1 1%TB 208438 131232 339670 2 n  
26 Day\_3 1%TB 12452545 614229 13066774 2 n  
27 Day\_5 1%TB 1710701 47489 1758190 2 n  
28 Day\_7 1%TB 328523 40374 368897 2 n  
29 Day\_1 MQ 51867 1119310 1171177 2 n  
30 Day\_3 MQ 128991 989171 1118162 2 n  
31 Day\_5 MQ 32239 330455 362694 2 n  
32 Day\_7 MQ 36665 181836 218501 2 n  
33 Day\_1 1%TB+PW+microorganism 69237 395171 464407 2 y  
34 Day\_3 1%TB+PW+microorganism 17030 40438 57468 2 y  
35 Day\_5 1%TB+PW+microorganism 914 45721 46635 2 y  
36 Day\_7 1%TB+PW+microorganism 761 6039 6800 2 y  
37 Day\_1 PW+microorganism 115428 21 115448 2 y  
38 Day\_3 PW+microorganism 17125 153 17279 2 y  
39 Day\_5 PW+microorganism 10937 783 11720 2 y  
40 Day\_7 PW+microorganism 2919 512 3431 2 y  
41 Day\_1 1%TB+PW-microorganism 258811 7160 265971 2 n  
42 Day\_3 1%TB+PW-microorganism 20758761 297759 21056520 2 n  
43 Day\_5 1%TB+PW-microorganism 2817437 1045302 3862739 2 n  
44 Day\_7 1%TB+PW-microorganism 417917 414911 832829 2 n  
45 Day\_1 PW-microorganism 19062 1190768 1209830 2 n  
46 Day\_3 PW-microorganism 50367 1243595 1293963 2 n  
47 Day\_5 PW-microorganism 81931 658323 740255 2 n  
48 Day\_7 PW-microorganism 22440 205975 228415 2 n  
49 Day\_1 1%TB 599345 92698 692043 3 n  
50 Day\_3 1%TB 13236028 269604 13505632 3 n  
51 Day\_5 1%TB 1037555 45837 1083392 3 n  
52 Day\_7 1%TB 406550 24700 431250 3 n  
53 Day\_1 MQ 52755 643894 696649 3 n  
54 Day\_3 MQ 78687 1077980 1156667 3 n  
55 Day\_5 MQ 47918 342203 390121 3 n  
56 Day\_7 MQ 28587 197452 226038 3 n  
57 Day\_1 1%TB+PW+microorganism 88247 409653 497901 3 y  
58 Day\_3 1%TB+PW+microorganism 9517 35543 45059 3 y  
59 Day\_5 1%TB+PW+microorganism 1167 12185 13351 3 y  
60 Day\_7 1%TB+PW+microorganism 1481 1087 2568 3 y  
61 Day\_1 PW+microorganism 8432 10 8441 3 y  
62 Day\_3 PW+microorganism 8370 483 8852 3 y  
63 Day\_5 PW+microorganism 8458 156 8615 3 y  
64 Day\_7 PW+microorganism 6079 233 6312 3 y  
65 Day\_1 1%TB+PW-microorganism 190323 23119 213442 3 n  
66 Day\_3 1%TB+PW-microorganism 16225944 364102 16590046 3 n  
67 Day\_5 1%TB+PW-microorganism 5265643 1196671 6462313 3 n  
68 Day\_7 1%TB+PW-microorganism 3295234 634350 3929585 3 n  
69 Day\_1 PW-microorganism 96892 1199922 1296814 3 n  
70 Day\_3 PW-microorganism 100570 1047328 1147898 3 n  
71 Day\_5 PW-microorganism 61803 670065 731868 3 n  
72 Day\_7 PW-microorganism 22352 206681 229033 3 n  
 water\_treatment TB day\_numeric log\_adh\_plus\_sup adh\_plus\_sup\_rounded  
1 sterile-water y 1 14.104089 1334529  
2 sterile-water y 3 16.485170 14435048  
3 sterile-water y 5 14.069517 1289180  
4 sterile-water y 7 12.936157 415051  
5 sterile-water n 1 13.976800 1175025  
6 sterile-water n 3 13.898556 1086591  
7 sterile-water n 5 12.851156 381229  
8 sterile-water n 7 12.299449 219575  
9 PW+MO y 1 13.038801 459917  
10 PW+MO y 3 10.706834 44660  
11 PW+MO y 5 10.743567 46331  
12 PW+MO y 7 8.882531 7205  
13 PW+MO n 1 11.062928 63763  
14 PW+MO n 3 9.691160 16174  
15 PW+MO n 5 9.686326 16096  
16 PW+MO n 7 9.440896 12593  
17 PW-MO y 1 10.416251 33398  
18 PW-MO y 3 16.572929 15759114  
19 PW-MO y 5 15.482279 5295029  
20 PW-MO y 7 15.079319 3538872  
21 PW-MO n 1 14.035002 1245443  
22 PW-MO n 3 14.052282 1267151  
23 PW-MO n 5 13.535187 755539  
24 PW-MO n 7 12.563219 285849  
25 sterile-water y 1 12.735730 339670  
26 sterile-water y 3 16.385583 13066774  
27 sterile-water y 5 14.379795 1758190  
28 sterile-water y 7 12.818273 368897  
29 sterile-water n 1 13.973520 1171177  
30 sterile-water n 3 13.927197 1118162  
31 sterile-water n 5 12.801315 362694  
32 sterile-water n 7 12.294546 218501  
33 PW+MO y 1 13.048517 464407  
34 PW+MO y 3 10.958984 57468  
35 PW+MO y 5 10.750107 46635  
36 PW+MO y 7 8.824678 6800  
37 PW+MO n 1 11.656575 115448  
38 PW+MO n 3 9.757247 17279  
39 PW+MO n 5 9.369052 11720  
40 PW+MO n 7 8.140607 3431  
41 PW-MO y 1 12.491143 265971  
42 PW-MO y 3 16.862721 21056520  
43 PW-MO y 5 15.166887 3862739  
44 PW-MO y 7 13.632584 832829  
45 PW-MO n 1 14.005990 1209830  
46 PW-MO n 3 14.073220 1293963  
47 PW-MO n 5 13.514750 740255  
48 PW-MO n 7 12.338919 228415  
49 sterile-water y 1 13.447403 692043  
50 sterile-water y 3 16.418617 13505632  
51 sterile-water y 5 13.895607 1083392  
52 sterile-water y 7 12.974443 431250  
53 sterile-water n 1 13.454037 696649  
54 sterile-water n 3 13.961053 1156667  
55 sterile-water n 5 12.874212 390121  
56 sterile-water n 7 12.328458 226038  
57 PW+MO y 1 13.118157 497901  
58 PW+MO y 3 10.715728 45059  
59 PW+MO y 5 9.499347 13351  
60 PW+MO y 7 7.850883 2568  
61 PW+MO n 1 9.040856 8441  
62 PW+MO n 3 9.088399 8852  
63 PW+MO n 5 9.061260 8615  
64 PW+MO n 7 8.750208 6312  
65 PW-MO y 1 12.271120 213442  
66 PW-MO y 3 16.624313 16590046  
67 PW-MO y 5 15.681498 6462313  
68 PW-MO y 7 15.184044 3929585  
69 PW-MO n 1 14.075421 1296814  
70 PW-MO n 3 13.953443 1147898  
71 PW-MO n 5 13.503355 731868  
72 PW-MO n 7 12.341621 229033

# normal distribution, should be relatively the same as the anova  
mod3\_glm <- glm(adh\_plus\_sup\_rounded ~ day \* TB \* water\_treatment,  
 data = pw\_noday0,  
 family = poisson(link = "log"))  
  
par(mfrow = c(2,2))  
plot(mod3\_glm) # look into how to interpret this with a poisson



summary(mod3\_glm) # ok this is sketch, I dont think it converged... look at those p values

Call:  
glm(formula = adh\_plus\_sup\_rounded ~ day \* TB \* water\_treatment,   
 family = poisson(link = "log"), data = pw\_noday0)  
  
Coefficients:  
 Estimate Std. Error z value Pr(>|z|)   
(Intercept) 13.8296932 0.0005733 24124.20 <2e-16 \*\*\*  
dayDay\_3 0.0995686 0.0007913 125.83 <2e-16 \*\*\*  
dayDay\_5 -0.9870049 0.0011002 -897.11 <2e-16 \*\*\*  
dayDay\_7 -1.5220964 0.0013544 -1123.81 <2e-16 \*\*\*  
TBy -0.2514919 0.0008667 -290.16 <2e-16 \*\*\*  
water\_treatmentPW-MO 0.2095173 0.0007715 271.58 <2e-16 \*\*\*  
water\_treatmentPW+MO -2.7859610 0.0023786 -1171.27 <2e-16 \*\*\*  
dayDay\_3:TBy 2.7528822 0.0010359 2657.43 <2e-16 \*\*\*  
dayDay\_5:TBy 1.5441638 0.0013694 1127.66 <2e-16 \*\*\*  
dayDay\_7:TBy 0.8557003 0.0017550 487.59 <2e-16 \*\*\*  
dayDay\_3:water\_treatmentPW-MO -0.1111153 0.0010781 -103.07 <2e-16 \*\*\*  
dayDay\_5:water\_treatmentPW-MO 0.4656453 0.0013878 335.54 <2e-16 \*\*\*  
dayDay\_7:water\_treatmentPW-MO -0.0968754 0.0018564 -52.18 <2e-16 \*\*\*  
dayDay\_3:water\_treatmentPW+MO -1.5892525 0.0054399 -292.14 <2e-16 \*\*\*  
dayDay\_5:water\_treatmentPW+MO -0.6521642 0.0058300 -111.86 <2e-16 \*\*\*  
dayDay\_7:water\_treatmentPW+MO -0.6062931 0.0072065 -84.13 <2e-16 \*\*\*  
TBy:water\_treatmentPW-MO -1.7386683 0.0017227 -1009.25 <2e-16 \*\*\*  
TBy:water\_treatmentPW+MO 2.2768805 0.0026045 874.21 <2e-16 \*\*\*  
dayDay\_3:TBy:water\_treatmentPW-MO 1.9044295 0.0018916 1006.80 <2e-16 \*\*\*  
dayDay\_5:TBy:water\_treatmentPW-MO 2.3936011 0.0021458 1115.46 <2e-16 \*\*\*  
dayDay\_7:TBy:water\_treatmentPW-MO 3.5475298 0.0026004 1364.20 <2e-16 \*\*\*  
dayDay\_3:TBy:water\_treatmentPW+MO -3.5314723 0.0061268 -576.40 <2e-16 \*\*\*  
dayDay\_5:TBy:water\_treatmentPW+MO -2.4985473 0.0066905 -373.45 <2e-16 \*\*\*  
dayDay\_7:TBy:water\_treatmentPW+MO -3.1795138 0.0106875 -297.50 <2e-16 \*\*\*  
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
  
(Dispersion parameter for poisson family taken to be 1)  
  
 Null deviance: 373695575 on 71 degrees of freedom  
Residual deviance: 5506365 on 48 degrees of freedom  
AIC: 5507455  
  
Number of Fisher Scoring iterations: 5

# all comparisons  
em <- emmeans(mod3\_glm, ~ day \* TB \* water\_treatment)  
# Perform the Tukey test for pairwise comparisons  
pairwise\_comparisons <- contrast(em, method = "pairwise", adjust = "tukey")  
summary(pairwise\_comparisons)

contrast estimate SE df  
 (Day\_1 n sterile-water) - (Day\_3 n sterile-water) -0.099569 0.00079128 Inf  
 (Day\_1 n sterile-water) - (Day\_5 n sterile-water) 0.987005 0.00110020 Inf  
 (Day\_1 n sterile-water) - (Day\_7 n sterile-water) 1.522096 0.00135440 Inf  
 (Day\_1 n sterile-water) - (Day\_1 y sterile-water) 0.251492 0.00086675 Inf  
 (Day\_1 n sterile-water) - (Day\_3 y sterile-water) -2.600959 0.00059416 Inf  
 (Day\_1 n sterile-water) - (Day\_5 y sterile-water) -0.305667 0.00075546 Inf  
 (Day\_1 n sterile-water) - (Day\_7 y sterile-water) 0.917888 0.00107310 Inf  
 (Day\_1 n sterile-water) - (Day\_1 n PW-MO) -0.209517 0.00077147 Inf  
 (Day\_1 n sterile-water) - (Day\_3 n PW-MO) -0.197971 0.00077347 Inf  
 (Day\_1 n sterile-water) - (Day\_5 n PW-MO) 0.311842 0.00088178 Inf  
 (Day\_1 n sterile-water) - (Day\_7 n PW-MO) 1.409454 0.00129383 Inf  
 (Day\_1 n sterile-water) - (Day\_1 y PW-MO) 1.780643 0.00150953 Inf  
 (Day\_1 n sterile-water) - (Day\_3 y PW-MO) -2.865122 0.00058938 Inf  
 (Day\_1 n sterile-water) - (Day\_5 y PW-MO) -1.635762 0.00062663 Inf  
 (Day\_1 n sterile-water) - (Day\_7 y PW-MO) -1.003616 0.00067015 Inf  
 (Day\_1 n sterile-water) - (Day\_1 n PW+MO) 2.785961 0.00237858 Inf  
 (Day\_1 n sterile-water) - (Day\_3 n PW+MO) 4.275645 0.00489556 Inf  
 (Day\_1 n sterile-water) - (Day\_5 n PW+MO) 4.425130 0.00527046 Inf  
 (Day\_1 n sterile-water) - (Day\_7 n PW+MO) 4.914350 0.00671561 Inf  
 (Day\_1 n sterile-water) - (Day\_1 y PW+MO) 0.760572 0.00101576 Inf  
 (Day\_1 n sterile-water) - (Day\_3 y PW+MO) 3.028846 0.00266884 Inf  
 (Day\_1 n sterile-water) - (Day\_5 y PW+MO) 3.354125 0.00312001 Inf  
 (Day\_1 n sterile-water) - (Day\_7 y PW+MO) 5.212775 0.00778895 Inf  
 (Day\_3 n sterile-water) - (Day\_5 n sterile-water) 1.086573 0.00108595 Inf  
 (Day\_3 n sterile-water) - (Day\_7 n sterile-water) 1.621665 0.00134286 Inf  
 (Day\_3 n sterile-water) - (Day\_1 y sterile-water) 0.351060 0.00084859 Inf  
 (Day\_3 n sterile-water) - (Day\_3 y sterile-water) -2.501390 0.00056734 Inf  
 (Day\_3 n sterile-water) - (Day\_5 y sterile-water) -0.206098 0.00073456 Inf  
 (Day\_3 n sterile-water) - (Day\_7 y sterile-water) 1.017456 0.00105849 Inf  
 (Day\_3 n sterile-water) - (Day\_1 n PW-MO) -0.109949 0.00075101 Inf  
 (Day\_3 n sterile-water) - (Day\_3 n PW-MO) -0.098402 0.00075307 Inf  
 (Day\_3 n sterile-water) - (Day\_5 n PW-MO) 0.411411 0.00086394 Inf  
 (Day\_3 n sterile-water) - (Day\_7 n PW-MO) 1.509023 0.00128174 Inf  
 (Day\_3 n sterile-water) - (Day\_1 y PW-MO) 1.880211 0.00149918 Inf  
 (Day\_3 n sterile-water) - (Day\_3 y PW-MO) -2.765554 0.00056233 Inf  
 (Day\_3 n sterile-water) - (Day\_5 y PW-MO) -1.536194 0.00060126 Inf  
 (Day\_3 n sterile-water) - (Day\_7 y PW-MO) -0.904047 0.00064650 Inf  
 (Day\_3 n sterile-water) - (Day\_1 n PW+MO) 2.885530 0.00237203 Inf  
 (Day\_3 n sterile-water) - (Day\_3 n PW+MO) 4.375214 0.00489238 Inf  
 (Day\_3 n sterile-water) - (Day\_5 n PW+MO) 4.524699 0.00526751 Inf  
 (Day\_3 n sterile-water) - (Day\_7 n PW+MO) 5.013919 0.00671329 Inf  
 (Day\_3 n sterile-water) - (Day\_1 y PW+MO) 0.860141 0.00100031 Inf  
 (Day\_3 n sterile-water) - (Day\_3 y PW+MO) 3.128415 0.00266300 Inf  
 (Day\_3 n sterile-water) - (Day\_5 y PW+MO) 3.453694 0.00311502 Inf  
 (Day\_3 n sterile-water) - (Day\_7 y PW+MO) 5.312344 0.00778695 Inf  
 (Day\_5 n sterile-water) - (Day\_7 n sterile-water) 0.535091 0.00154517 Inf  
 (Day\_5 n sterile-water) - (Day\_1 y sterile-water) -0.735513 0.00114211 Inf  
 (Day\_5 n sterile-water) - (Day\_3 y sterile-water) -3.587964 0.00095194 Inf  
 (Day\_5 n sterile-water) - (Day\_5 y sterile-water) -1.292672 0.00106014 Inf  
 (Day\_5 n sterile-water) - (Day\_7 y sterile-water) -0.069117 0.00130565 Inf  
 (Day\_5 n sterile-water) - (Day\_1 n PW-MO) -1.196522 0.00107160 Inf  
 (Day\_5 n sterile-water) - (Day\_3 n PW-MO) -1.184976 0.00107304 Inf  
 (Day\_5 n sterile-water) - (Day\_5 n PW-MO) -0.675163 0.00115356 Inf  
 (Day\_5 n sterile-water) - (Day\_7 n PW-MO) 0.422450 0.00149237 Inf  
 (Day\_5 n sterile-water) - (Day\_1 y PW-MO) 0.793638 0.00168281 Inf  
 (Day\_5 n sterile-water) - (Day\_3 y PW-MO) -3.852127 0.00094896 Inf  
 (Day\_5 n sterile-water) - (Day\_5 y PW-MO) -2.622767 0.00097253 Inf  
 (Day\_5 n sterile-water) - (Day\_7 y PW-MO) -1.990620 0.00100113 Inf  
 (Day\_5 n sterile-water) - (Day\_1 n PW+MO) 1.798956 0.00249215 Inf  
 (Day\_5 n sterile-water) - (Day\_3 n PW+MO) 3.288640 0.00495173 Inf  
 (Day\_5 n sterile-water) - (Day\_5 n PW+MO) 3.438125 0.00532268 Inf  
 (Day\_5 n sterile-water) - (Day\_7 n PW+MO) 3.927346 0.00675667 Inf  
 (Day\_5 n sterile-water) - (Day\_1 y PW+MO) -0.226433 0.00125894 Inf  
 (Day\_5 n sterile-water) - (Day\_3 y PW+MO) 2.041841 0.00277054 Inf  
 (Day\_5 n sterile-water) - (Day\_5 y PW+MO) 2.367120 0.00320743 Inf  
 (Day\_5 n sterile-water) - (Day\_7 y PW+MO) 4.225770 0.00782438 Inf  
 (Day\_7 n sterile-water) - (Day\_1 y sterile-water) -1.270605 0.00138866 Inf  
 (Day\_7 n sterile-water) - (Day\_3 y sterile-water) -4.123055 0.00123699 Inf  
 (Day\_7 n sterile-water) - (Day\_5 y sterile-water) -1.827763 0.00132206 Inf  
 (Day\_7 n sterile-water) - (Day\_7 y sterile-water) -0.604208 0.00152600 Inf  
 (Day\_7 n sterile-water) - (Day\_1 n PW-MO) -1.731614 0.00133127 Inf  
 (Day\_7 n sterile-water) - (Day\_3 n PW-MO) -1.720067 0.00133243 Inf  
 (Day\_7 n sterile-water) - (Day\_5 n PW-MO) -1.210254 0.00139809 Inf  
 (Day\_7 n sterile-water) - (Day\_7 n PW-MO) -0.112642 0.00168853 Inf  
 (Day\_7 n sterile-water) - (Day\_1 y PW-MO) 0.258546 0.00185898 Inf  
 (Day\_7 n sterile-water) - (Day\_3 y PW-MO) -4.387219 0.00123470 Inf  
 (Day\_7 n sterile-water) - (Day\_5 y PW-MO) -3.157859 0.00125291 Inf  
 (Day\_7 n sterile-water) - (Day\_7 y PW-MO) -2.525712 0.00127524 Inf  
 (Day\_7 n sterile-water) - (Day\_1 n PW+MO) 1.263865 0.00261434 Inf  
 (Day\_7 n sterile-water) - (Day\_3 n PW+MO) 2.753549 0.00501434 Inf  
 (Day\_7 n sterile-water) - (Day\_5 n PW+MO) 2.903034 0.00538098 Inf  
 (Day\_7 n sterile-water) - (Day\_7 n PW+MO) 3.392254 0.00680269 Inf  
 (Day\_7 n sterile-water) - (Day\_1 y PW+MO) -0.761524 0.00148623 Inf  
 (Day\_7 n sterile-water) - (Day\_3 y PW+MO) 1.506750 0.00288095 Inf  
 (Day\_7 n sterile-water) - (Day\_5 y PW+MO) 1.832029 0.00330327 Inf  
 (Day\_7 n sterile-water) - (Day\_7 y PW+MO) 3.690679 0.00786415 Inf  
 (Day\_1 y sterile-water) - (Day\_3 y sterile-water) -2.852451 0.00066858 Inf  
 (Day\_1 y sterile-water) - (Day\_5 y sterile-water) -0.557159 0.00081529 Inf  
 (Day\_1 y sterile-water) - (Day\_7 y sterile-water) 0.666396 0.00111603 Inf  
 (Day\_1 y sterile-water) - (Day\_1 n PW-MO) -0.461009 0.00083014 Inf  
 (Day\_1 y sterile-water) - (Day\_3 n PW-MO) -0.449462 0.00083200 Inf  
 (Day\_1 y sterile-water) - (Day\_5 n PW-MO) 0.060350 0.00093355 Inf  
 (Day\_1 y sterile-water) - (Day\_7 n PW-MO) 1.157963 0.00132965 Inf  
 (Day\_1 y sterile-water) - (Day\_1 y PW-MO) 1.529151 0.00154034 Inf  
 (Day\_1 y sterile-water) - (Day\_3 y PW-MO) -3.116614 0.00066433 Inf  
 (Day\_1 y sterile-water) - (Day\_5 y PW-MO) -1.887254 0.00069759 Inf  
 (Day\_1 y sterile-water) - (Day\_7 y PW-MO) -1.255107 0.00073694 Inf  
 (Day\_1 y sterile-water) - (Day\_1 n PW+MO) 2.534469 0.00239825 Inf  
 (Day\_1 y sterile-water) - (Day\_3 n PW+MO) 4.024153 0.00490515 Inf  
 (Day\_1 y sterile-water) - (Day\_5 n PW+MO) 4.173638 0.00527937 Inf  
 (Day\_1 y sterile-water) - (Day\_7 n PW+MO) 4.662859 0.00672260 Inf  
 (Day\_1 y sterile-water) - (Day\_1 y PW+MO) 0.509080 0.00106101 Inf  
 (Day\_1 y sterile-water) - (Day\_3 y PW+MO) 2.777354 0.00268639 Inf  
 (Day\_1 y sterile-water) - (Day\_5 y PW+MO) 3.102633 0.00313503 Inf  
 (Day\_1 y sterile-water) - (Day\_7 y PW+MO) 4.961283 0.00779498 Inf  
 (Day\_3 y sterile-water) - (Day\_5 y sterile-water) 2.295292 0.00051621 Inf  
 (Day\_3 y sterile-water) - (Day\_7 y sterile-water) 3.518847 0.00092049 Inf  
 (Day\_3 y sterile-water) - (Day\_1 n PW-MO) 2.391442 0.00053936 Inf  
 (Day\_3 y sterile-water) - (Day\_3 n PW-MO) 2.402988 0.00054222 Inf  
 (Day\_3 y sterile-water) - (Day\_5 n PW-MO) 2.912801 0.00068796 Inf  
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 (Day\_3 y sterile-water) - (Day\_3 y PW-MO) -0.264163 0.00020763 Inf  
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 (Day\_3 y sterile-water) - (Day\_5 y PW+MO) 5.955084 0.00307087 Inf  
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 (Day\_5 y sterile-water) - (Day\_1 n PW-MO) 0.096150 0.00071316 Inf  
 (Day\_5 y sterile-water) - (Day\_3 n PW-MO) 0.107696 0.00071533 Inf  
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 (Day\_5 y sterile-water) - (Day\_3 n PW+MO) 4.581312 0.00488671 Inf  
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 (Day\_5 y sterile-water) - (Day\_3 y PW+MO) 3.334513 0.00265258 Inf  
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 (Day\_5 y sterile-water) - (Day\_7 y PW+MO) 5.518442 0.00778339 Inf  
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 (Day\_7 y sterile-water) - (Day\_7 y PW-MO) -1.921503 0.00097127 Inf  
 (Day\_7 y sterile-water) - (Day\_1 n PW+MO) 1.868073 0.00248031 Inf  
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 (Day\_7 y sterile-water) - (Day\_5 n PW+MO) 3.507242 0.00531715 Inf  
 (Day\_7 y sterile-water) - (Day\_7 n PW+MO) 3.996463 0.00675231 Inf  
 (Day\_7 y sterile-water) - (Day\_1 y PW+MO) -0.157316 0.00123533 Inf  
 (Day\_7 y sterile-water) - (Day\_3 y PW+MO) 2.110958 0.00275989 Inf  
 (Day\_7 y sterile-water) - (Day\_5 y PW+MO) 2.436237 0.00319824 Inf  
 (Day\_7 y sterile-water) - (Day\_7 y PW+MO) 4.294887 0.00782061 Inf  
 (Day\_1 n PW-MO) - (Day\_3 n PW-MO) 0.011547 0.00073221 Inf  
 (Day\_1 n PW-MO) - (Day\_5 n PW-MO) 0.521360 0.00084583 Inf  
 (Day\_1 n PW-MO) - (Day\_7 n PW-MO) 1.618972 0.00126960 Inf  
 (Day\_1 n PW-MO) - (Day\_1 y PW-MO) 1.990160 0.00148881 Inf  
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 (Day\_1 n PW-MO) - (Day\_5 y PW-MO) -1.426245 0.00057493 Inf  
 (Day\_1 n PW-MO) - (Day\_7 y PW-MO) -0.794098 0.00062208 Inf  
 (Day\_1 n PW-MO) - (Day\_1 n PW+MO) 2.995478 0.00236549 Inf  
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 (Day\_1 n PW-MO) - (Day\_5 n PW+MO) 4.634647 0.00526457 Inf  
 (Day\_1 n PW-MO) - (Day\_7 n PW+MO) 5.123868 0.00671098 Inf  
 (Day\_1 n PW-MO) - (Day\_1 y PW+MO) 0.970090 0.00098470 Inf  
 (Day\_1 n PW-MO) - (Day\_3 y PW+MO) 3.238364 0.00265718 Inf  
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 (Day\_3 n PW-MO) - (Day\_1 n PW+MO) 2.983932 0.00236614 Inf  
 (Day\_3 n PW-MO) - (Day\_3 n PW+MO) 4.473616 0.00488953 Inf  
 (Day\_3 n PW-MO) - (Day\_5 n PW+MO) 4.623101 0.00526486 Inf  
 (Day\_3 n PW-MO) - (Day\_7 n PW+MO) 5.112321 0.00671121 Inf  
 (Day\_3 n PW-MO) - (Day\_1 y PW+MO) 0.958543 0.00098627 Inf  
 (Day\_3 n PW-MO) - (Day\_3 y PW+MO) 3.226817 0.00265776 Inf  
 (Day\_3 n PW-MO) - (Day\_5 y PW+MO) 3.552096 0.00311054 Inf  
 (Day\_3 n PW-MO) - (Day\_7 y PW+MO) 5.410746 0.00778516 Inf  
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 (Day\_5 n PW-MO) - (Day\_7 y PW-MO) -1.315458 0.00075456 Inf  
 (Day\_5 n PW-MO) - (Day\_1 n PW+MO) 2.474119 0.00240373 Inf  
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 (Day\_5 n PW-MO) - (Day\_5 n PW+MO) 4.113288 0.00528186 Inf  
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 (Day\_5 n PW-MO) - (Day\_1 y PW+MO) 0.448730 0.00107332 Inf  
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 (Day\_5 n PW-MO) - (Day\_5 y PW+MO) 3.042283 0.00313922 Inf  
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 (Day\_3 y PW-MO) - (Day\_5 n PW+MO) 7.290252 0.00524098 Inf  
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 (Day\_1 n PW+MO) - (Day\_7 n PW+MO) 2.128389 0.00707812 Inf  
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 (Day\_3 y PW+MO) - (Day\_7 y PW+MO) 2.183929 0.00819348 Inf  
 (Day\_5 y PW+MO) - (Day\_7 y PW+MO) 1.858650 0.00835134 Inf  
 z.ratio p.value  
 -125.831 <.0001  
 897.114 <.0001  
 1123.814 <.0001  
 290.156 <.0001  
 -4377.547 <.0001  
 -404.608 <.0001  
 855.358 <.0001  
 -271.584 <.0001  
 -255.952 <.0001  
 353.650 <.0001  
 1089.366 <.0001  
 1179.602 <.0001  
 -4861.283 <.0001  
 -2610.431 <.0001  
 -1497.596 <.0001  
 1171.270 <.0001  
 873.372 <.0001  
 839.609 <.0001  
 731.780 <.0001  
 748.774 <.0001  
 1134.892 <.0001  
 1075.036 <.0001  
 669.253 <.0001  
 1000.572 <.0001  
 1207.625 <.0001  
 413.699 <.0001  
 -4408.949 <.0001  
 -280.574 <.0001  
 961.232 <.0001  
 -146.402 <.0001  
 -130.669 <.0001  
 476.202 <.0001  
 1177.326 <.0001  
 1254.163 <.0001  
 -4918.004 <.0001  
 -2554.958 <.0001  
 -1398.381 <.0001  
 1216.483 <.0001  
 894.292 <.0001  
 858.983 <.0001  
 746.865 <.0001  
 859.876 <.0001  
 1174.771 <.0001  
 1108.724 <.0001  
 682.211 <.0001  
 346.298 <.0001  
 -643.996 <.0001  
 -3769.115 <.0001  
 -1219.347 <.0001  
 -52.937 <.0001  
 -1116.579 <.0001  
 -1104.317 <.0001  
 -585.286 <.0001  
 283.074 <.0001  
 471.616 <.0001  
 -4059.316 <.0001  
 -2696.842 <.0001  
 -1988.372 <.0001  
 721.849 <.0001  
 664.139 <.0001  
 645.938 <.0001  
 581.255 <.0001  
 -179.860 <.0001  
 736.984 <.0001  
 738.011 <.0001  
 540.077 <.0001  
 -914.986 <.0001  
 -3333.128 <.0001  
 -1382.508 <.0001  
 -395.943 <.0001  
 -1300.722 <.0001  
 -1290.921 <.0001  
 -865.646 <.0001  
 -66.710 <.0001  
 139.080 <.0001  
 -3553.260 <.0001  
 -2520.418 <.0001  
 -1980.583 <.0001  
 483.435 <.0001  
 549.134 <.0001  
 539.499 <.0001  
 498.664 <.0001  
 -512.385 <.0001  
 523.005 <.0001  
 554.610 <.0001  
 469.304 <.0001  
 -4266.443 <.0001  
 -683.388 <.0001  
 597.113 <.0001  
 -555.340 <.0001  
 -540.219 <.0001  
 64.646 <.0001  
 870.878 <.0001  
 992.736 <.0001  
 -4691.357 <.0001  
 -2705.394 <.0001  
 -1703.144 <.0001  
 1056.798 <.0001  
 820.394 <.0001  
 790.556 <.0001  
 693.609 <.0001  
 479.809 <.0001  
 1033.861 <.0001  
 989.665 <.0001  
 636.472 <.0001  
 4446.438 <.0001  
 3822.808 <.0001  
 4433.889 <.0001  
 4431.783 <.0001  
 4233.978 <.0001  
 3426.649 <.0001  
 3118.264 <.0001  
 -1272.276 <.0001  
 3246.198 <.0001  
 4197.014 <.0001  
 2328.229 <.0001  
 1413.663 <.0001  
 1340.468 <.0001  
 1122.875 <.0001  
 3941.104 <.0001  
 2156.007 <.0001  
 1939.220 <.0001  
 1005.707 <.0001  
 1185.630 <.0001  
 134.821 <.0001  
 150.554 <.0001  
 742.863 <.0001  
 1361.275 <.0001  
 1409.115 <.0001  
 -5011.697 <.0001  
 -2404.068 <.0001  
 -1159.151 <.0001  
 1309.836 <.0001  
 937.504 <.0001  
 899.007 <.0001  
 778.043 <.0001  
 1096.707 <.0001  
 1257.084 <.0001  
 1178.256 <.0001  
 709.002 <.0001  
 -1080.141 <.0001  
 -1067.563 <.0001  
 -537.395 <.0001  
 333.830 <.0001  
 518.104 <.0001  
 -4123.589 <.0001  
 -2711.543 <.0001  
 -1978.332 <.0001  
 753.162 <.0001  
 678.913 <.0001  
 659.610 <.0001  
 591.866 <.0001  
 -127.347 <.0001  
 764.871 <.0001  
 761.743 <.0001  
 549.175 <.0001  
 15.770 <.0001  
 616.392 <.0001  
 1275.186 <.0001  
 1336.746 <.0001  
 -4972.285 <.0001  
 -2480.751 <.0001  
 -1276.524 <.0001  
 1266.326 <.0001  
 917.359 <.0001  
 880.347 <.0001  
 763.505 <.0001  
 985.159 <.0001  
 1218.723 <.0001  
 1145.851 <.0001  
 696.509 <.0001  
 601.441 <.0001  
 1264.877 <.0001  
 1328.063 <.0001  
 -4967.028 <.0001  
 -2489.207 <.0001  
 -1289.937 <.0001  
 1261.096 <.0001  
 914.938 <.0001  
 878.105 <.0001  
 761.758 <.0001  
 971.883 <.0001  
 1214.111 <.0001  
 1141.955 <.0001  
 695.008 <.0001  
 819.420 <.0001  
 948.317 <.0001  
 -4645.828 <.0001  
 -2719.415 <.0001  
 -1743.339 <.0001  
 1029.284 <.0001  
 807.649 <.0001  
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 684.433 <.0001  
 418.075 <.0001  
 1009.559 <.0001  
 969.119 <.0001  
 628.593 <.0001  
 204.475 <.0001  
 -3659.931 <.0001  
 -2565.102 <.0001  
 -1993.102 <.0001  
 532.811 <.0001  
 573.430 <.0001  
 561.992 <.0001  
 516.118 <.0001  
 -453.367 <.0001  
 567.616 <.0001  
 593.086 <.0001  
 484.256 <.0001  
 -3311.012 <.0001  
 -2407.319 <.0001  
 -1934.960 <.0001  
 372.620 <.0001  
 493.235 <.0001  
 487.724 <.0001  
 458.462 <.0001  
 -626.251 <.0001  
 422.112 <.0001  
 466.930 <.0001  
 434.868 <.0001  
 4273.747 <.0001  
 4989.579 <.0001  
 2443.693 <.0001  
 1468.144 <.0001  
 1391.009 <.0001  
 1162.417 <.0001  
 4267.448 <.0001  
 2258.109 <.0001  
 2025.850 <.0001  
 1039.756 <.0001  
 1471.768 <.0001  
 1904.036 <.0001  
 1214.226 <.0001  
 1155.490 <.0001  
 978.230 <.0001  
 2735.956 <.0001  
 1781.203 <.0001  
 1621.508 <.0001  
 881.187 <.0001  
 1623.354 <.0001  
 1083.091 <.0001  
 1033.913 <.0001  
 883.266 <.0001  
 1943.973 <.0001  
 1533.517 <.0001  
 1411.885 <.0001  
 799.477 <.0001  
 276.785 <.0001  
 286.307 <.0001  
 300.700 <.0001  
 -824.656 <.0001  
 69.758 <.0001  
 148.013 <.0001  
 299.474 <.0001  
 20.914 <.0001  
 77.223 <.0001  
 -712.468 <.0001  
 -226.012 <.0001  
 -160.310 <.0001  
 102.263 <.0001  
 57.567 <.0001  
 -690.661 <.0001  
 -238.609 <.0001  
 -176.418 <.0001  
 84.064 <.0001  
 -615.974 <.0001  
 -262.573 <.0001  
 -211.973 <.0001  
 29.108 <.0001  
 828.411 <.0001  
 815.721 <.0001  
 569.849 <.0001  
 80.816 <.0001  
 266.545 <.0001  
 222.557 <.0001  
  
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 24 estimates

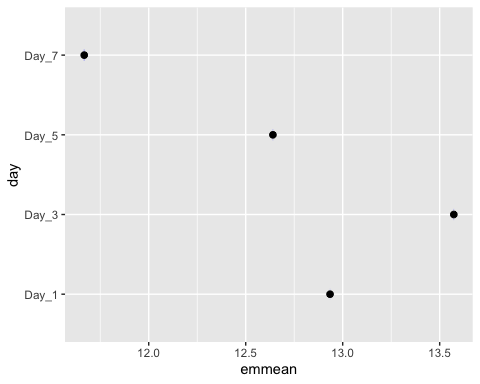
## First order comparisons  
  
# Pairwise comparisons for 'day'  
# Day 3 > Day 1 = Day 5 > Day 7  
pairwise\_day\_2b <- emmeans(mod3\_glm, pairwise ~ day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_day\_2b # df infinity?? definitely sketchy

$emmeans  
 day emmean SE df asymp.LCL asymp.UCL  
 Day\_1 12.935 0.00050000 Inf 12.934 12.936  
 Day\_3 13.573 0.00092859 Inf 13.571 13.575  
 Day\_5 12.640 0.00103403 Inf 12.638 12.642  
 Day\_7 11.668 0.00173929 Inf 11.664 11.671  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df z.ratio p.value  
 Day\_1 - Day\_3 -0.6380 0.001055 Inf -604.986 <.0001  
 Day\_1 - Day\_5 0.2946 0.001149 Inf 256.481 <.0001  
 Day\_1 - Day\_7 1.2673 0.001810 Inf 700.270 <.0001  
 Day\_3 - Day\_5 0.9326 0.001390 Inf 671.064 <.0001  
 Day\_3 - Day\_7 1.9053 0.001972 Inf 966.372 <.0001  
 Day\_5 - Day\_7 0.9727 0.002023 Inf 480.721 <.0001  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 4 estimates

plot(pairwise\_day\_2b)



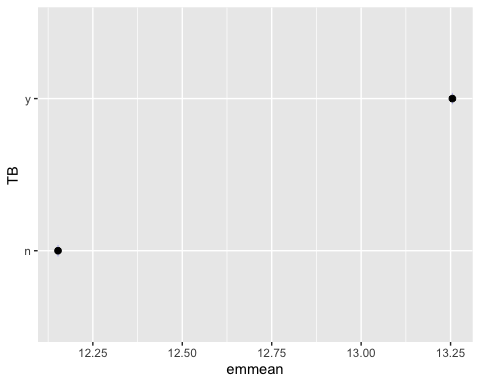
# Pairwise comparisons for 'TB'  
# note I dont need to test this bc its only 2 levels, bc I am "wasting" df  
# or bonferroni comparisons by hand is another option  
pairwise\_TB\_2b <- emmeans(mod3\_glm, pairwise ~ TB, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_TB\_2b

$emmeans  
 TB emmean SE df asymp.LCL asymp.UCL  
 n 12.153 0.00086011 Inf 12.151 12.154  
 y 13.255 0.00074957 Inf 13.254 13.257  
  
Results are averaged over the levels of: day, water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df z.ratio p.value  
 n - y -1.102 0.001141 Inf -966.284 <.0001  
  
Results are averaged over the levels of: day, water\_treatment   
Results are given on the log (not the response) scale.

plot(pairwise\_TB\_2b)



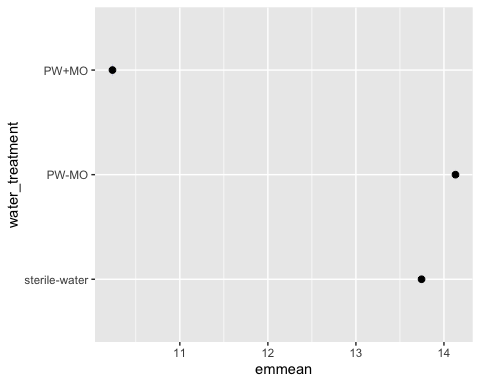
# Pairwise comparisons for 'water\_treatment'  
pairwise\_water\_treatment\_2b <- emmeans(mod3\_glm, pairwise ~ water\_treatment, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_water\_treatment\_2b

$emmeans  
 water\_treatment emmean SE df asymp.LCL asymp.UCL  
 sterile-water 13.7457 0.000265921 Inf 13.7451 13.7462  
 PW-MO 14.1309 0.000264682 Inf 14.1304 14.1315  
 PW+MO 10.2350 0.001669716 Inf 10.2317 10.2383  
  
Results are averaged over the levels of: day, TB   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df z.ratio p.value  
 (sterile-water) - (PW-MO) -0.3853 0.0003752 Inf -1026.913 <.0001  
 (sterile-water) - (PW+MO) 3.5106 0.0016908 Inf 2076.369 <.0001  
 (PW-MO) - (PW+MO) 3.8959 0.0016906 Inf 2304.515 <.0001  
  
Results are averaged over the levels of: day, TB   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 3 estimates

plot(pairwise\_water\_treatment\_2b)



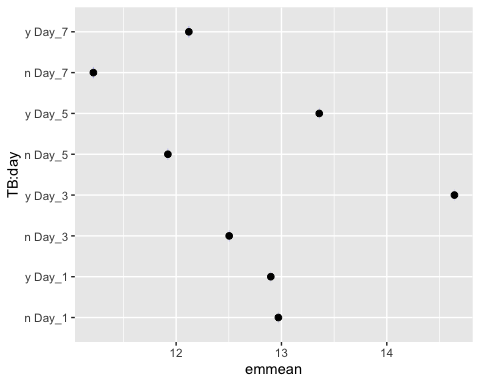
## second order comparisons  
  
# day:TB  
pairwise\_day\_TB\_2b <- emmeans(mod3\_glm, pairwise ~ TB \* day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_day\_TB\_2b

$emmeans  
 TB day emmean SE df asymp.LCL asymp.UCL  
 n Day\_1 12.971 0.00081132 Inf 12.969 12.972  
 y Day\_1 12.899 0.00058460 Inf 12.898 12.900  
 n Day\_3 12.504 0.00163995 Inf 12.500 12.507  
 y Day\_3 14.642 0.00087160 Inf 14.640 14.644  
 n Day\_5 11.922 0.00178823 Inf 11.918 11.925  
 y Day\_5 13.359 0.00103880 Inf 13.357 13.361  
 n Day\_7 11.214 0.00230029 Inf 11.210 11.219  
 y Day\_7 12.121 0.00260944 Inf 12.116 12.126  
  
Results are averaged over the levels of: water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df z.ratio p.value  
 n Day\_1 - y Day\_1 0.07209 0.001000 Inf 72.088 <.0001  
 n Day\_1 - n Day\_3 0.46722 0.001830 Inf 255.358 <.0001  
 n Day\_1 - y Day\_3 -1.67123 0.001191 Inf -1403.486 <.0001  
 n Day\_1 - n Day\_5 1.04918 0.001964 Inf 534.294 <.0001  
 n Day\_1 - y Day\_5 -0.38792 0.001318 Inf -294.303 <.0001  
 n Day\_1 - n Day\_7 1.75649 0.002439 Inf 720.116 <.0001  
 n Day\_1 - y Day\_7 0.85020 0.002733 Inf 311.126 <.0001  
 y Day\_1 - n Day\_3 0.39513 0.001741 Inf 226.953 <.0001  
 y Day\_1 - y Day\_3 -1.74331 0.001049 Inf -1661.098 <.0001  
 y Day\_1 - n Day\_5 0.97709 0.001881 Inf 519.353 <.0001  
 y Day\_1 - y Day\_5 -0.46000 0.001192 Inf -385.910 <.0001  
 y Day\_1 - n Day\_7 1.68440 0.002373 Inf 709.695 <.0001  
 y Day\_1 - y Day\_7 0.77811 0.002674 Inf 290.979 <.0001  
 n Day\_3 - y Day\_3 -2.13845 0.001857 Inf -1151.446 <.0001  
 n Day\_3 - n Day\_5 0.58196 0.002426 Inf 239.848 <.0001  
 n Day\_3 - y Day\_5 -0.85514 0.001941 Inf -440.503 <.0001  
 n Day\_3 - n Day\_7 1.28927 0.002825 Inf 456.373 <.0001  
 n Day\_3 - y Day\_7 0.38298 0.003082 Inf 124.264 <.0001  
 y Day\_3 - n Day\_5 2.72040 0.001989 Inf 1367.495 <.0001  
 y Day\_3 - y Day\_5 1.28331 0.001356 Inf 946.380 <.0001  
 y Day\_3 - n Day\_7 3.42771 0.002460 Inf 1393.447 <.0001  
 y Day\_3 - y Day\_7 2.52143 0.002751 Inf 916.498 <.0001  
 n Day\_5 - y Day\_5 -1.43709 0.002068 Inf -694.900 <.0001  
 n Day\_5 - n Day\_7 0.70731 0.002914 Inf 242.761 <.0001  
 n Day\_5 - y Day\_7 -0.19898 0.003163 Inf -62.900 <.0001  
 y Day\_5 - n Day\_7 2.14440 0.002524 Inf 849.614 <.0001  
 y Day\_5 - y Day\_7 1.23812 0.002809 Inf 440.830 <.0001  
 n Day\_7 - y Day\_7 -0.90629 0.003479 Inf -260.533 <.0001  
  
Results are averaged over the levels of: water\_treatment   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 8 estimates

plot(pairwise\_day\_TB\_2b)



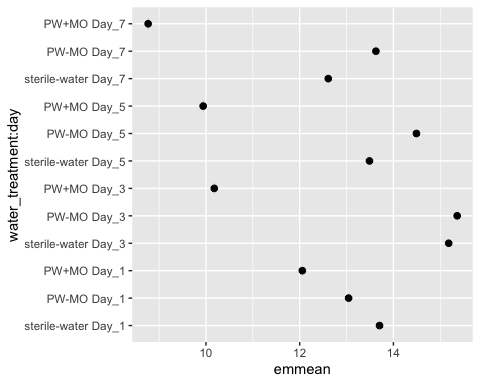
# day:water\_treatment  
pairwise\_water\_treatment\_day\_2b <- emmeans(mod3\_glm, pairwise ~ water\_treatment \* day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_water\_treatment\_day\_2b

$emmeans  
 water\_treatment day emmean SE df asymp.LCL asymp.UCL  
 sterile-water Day\_1 13.70395 0.000433373 Inf 13.70310 13.70480  
 PW-MO Day\_1 13.04413 0.000744405 Inf 13.04267 13.04559  
 PW+MO Day\_1 12.05643 0.001228020 Inf 12.05402 12.05883  
 sterile-water Day\_3 15.17996 0.000283672 Inf 15.17940 15.18051  
 PW-MO Day\_3 15.36124 0.000268486 Inf 15.36071 15.36177  
 PW+MO Day\_3 10.17745 0.002758258 Inf 10.17204 10.18285  
 sterile-water Day\_5 13.48902 0.000530067 Inf 13.48799 13.49006  
 PW-MO Day\_5 14.49165 0.000358093 Inf 14.49095 14.49235  
 PW+MO Day\_5 9.94007 0.003035415 Inf 9.93412 9.94601  
 sterile-water Day\_7 12.60970 0.000763000 Inf 12.60821 12.61120  
 PW-MO Day\_7 13.62677 0.000605355 Inf 13.62559 13.62796  
 PW+MO Day\_7 8.76613 0.005126155 Inf 8.75608 8.77618  
  
Results are averaged over the levels of: TB   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df z.ratio  
 (sterile-water Day\_1) - (PW-MO Day\_1) 0.65982 0.0008614 Inf 766.012  
 (sterile-water Day\_1) - (PW+MO Day\_1) 1.64752 0.0013022 Inf 1265.137  
 (sterile-water Day\_1) - (sterile-water Day\_3) -1.47601 0.0005180 Inf -2849.661  
 (sterile-water Day\_1) - (PW-MO Day\_3) -1.65729 0.0005098 Inf -3250.861  
 (sterile-water Day\_1) - (PW+MO Day\_3) 3.52650 0.0027921 Inf 1263.030  
 (sterile-water Day\_1) - (sterile-water Day\_5) 0.21492 0.0006847 Inf 313.904  
 (sterile-water Day\_1) - (PW-MO Day\_5) -0.78771 0.0005622 Inf -1401.171  
 (sterile-water Day\_1) - (PW+MO Day\_5) 3.76388 0.0030662 Inf 1227.541  
 (sterile-water Day\_1) - (sterile-water Day\_7) 1.09425 0.0008775 Inf 1247.024  
 (sterile-water Day\_1) - (PW-MO Day\_7) 0.07717 0.0007445 Inf 103.659  
 (sterile-water Day\_1) - (PW+MO Day\_7) 4.93782 0.0051444 Inf 959.835  
 (PW-MO Day\_1) - (PW+MO Day\_1) 0.98770 0.0014360 Inf 687.803  
 (PW-MO Day\_1) - (sterile-water Day\_3) -2.13583 0.0007966 Inf -2681.100  
 (PW-MO Day\_1) - (PW-MO Day\_3) -2.31711 0.0007913 Inf -2928.073  
 (PW-MO Day\_1) - (PW+MO Day\_3) 2.86668 0.0028569 Inf 1003.409  
 (PW-MO Day\_1) - (sterile-water Day\_5) -0.44489 0.0009138 Inf -486.838  
 (PW-MO Day\_1) - (PW-MO Day\_5) -1.44752 0.0008261 Inf -1752.330  
 (PW-MO Day\_1) - (PW+MO Day\_5) 3.10406 0.0031254 Inf 993.186  
 (PW-MO Day\_1) - (sterile-water Day\_7) 0.43443 0.0010660 Inf 407.541  
 (PW-MO Day\_1) - (PW-MO Day\_7) -0.58264 0.0009595 Inf -607.252  
 (PW-MO Day\_1) - (PW+MO Day\_7) 4.27800 0.0051799 Inf 825.881  
 (PW+MO Day\_1) - (sterile-water Day\_3) -3.12353 0.0012604 Inf -2478.287  
 (PW+MO Day\_1) - (PW-MO Day\_3) -3.30481 0.0012570 Inf -2629.070  
 (PW+MO Day\_1) - (PW+MO Day\_3) 1.87898 0.0030193 Inf 622.328  
 (PW+MO Day\_1) - (sterile-water Day\_5) -1.43260 0.0013375 Inf -1071.071  
 (PW+MO Day\_1) - (PW-MO Day\_5) -2.43523 0.0012792 Inf -1903.762  
 (PW+MO Day\_1) - (PW+MO Day\_5) 2.11636 0.0032744 Inf 646.333  
 (PW+MO Day\_1) - (sterile-water Day\_7) -0.55327 0.0014458 Inf -382.689  
 (PW+MO Day\_1) - (PW-MO Day\_7) -1.57035 0.0013691 Inf -1146.976  
 (PW+MO Day\_1) - (PW+MO Day\_7) 3.29030 0.0052712 Inf 624.203  
 (sterile-water Day\_3) - (PW-MO Day\_3) -0.18128 0.0003906 Inf -464.135  
 (sterile-water Day\_3) - (PW+MO Day\_3) 5.00251 0.0027728 Inf 1804.132  
 (sterile-water Day\_3) - (sterile-water Day\_5) 1.69093 0.0006012 Inf 2812.597  
 (sterile-water Day\_3) - (PW-MO Day\_5) 0.68830 0.0004568 Inf 1506.672  
 (sterile-water Day\_3) - (PW+MO Day\_5) 5.23989 0.0030486 Inf 1718.763  
 (sterile-water Day\_3) - (sterile-water Day\_7) 2.57026 0.0008140 Inf 3157.460  
 (sterile-water Day\_3) - (PW-MO Day\_7) 1.55318 0.0006685 Inf 2323.301  
 (sterile-water Day\_3) - (PW+MO Day\_7) 6.41383 0.0051340 Inf 1249.285  
 (PW-MO Day\_3) - (PW+MO Day\_3) 5.18379 0.0027713 Inf 1870.531  
 (PW-MO Day\_3) - (sterile-water Day\_5) 1.87221 0.0005942 Inf 3150.895  
 (PW-MO Day\_3) - (PW-MO Day\_5) 0.86959 0.0004476 Inf 1942.925  
 (PW-MO Day\_3) - (PW+MO Day\_5) 5.42117 0.0030473 Inf 1779.029  
 (PW-MO Day\_3) - (sterile-water Day\_7) 2.75154 0.0008089 Inf 3401.751  
 (PW-MO Day\_3) - (PW-MO Day\_7) 1.73447 0.0006622 Inf 2619.156  
 (PW-MO Day\_3) - (PW+MO Day\_7) 6.59511 0.0051332 Inf 1284.800  
 (PW+MO Day\_3) - (sterile-water Day\_5) -3.31158 0.0028087 Inf -1179.030  
 (PW+MO Day\_3) - (PW-MO Day\_5) -4.31421 0.0027814 Inf -1551.088  
 (PW+MO Day\_3) - (PW+MO Day\_5) 0.23738 0.0041014 Inf 57.878  
 (PW+MO Day\_3) - (sterile-water Day\_7) -2.43225 0.0028618 Inf -849.890  
 (PW+MO Day\_3) - (PW-MO Day\_7) -3.44933 0.0028239 Inf -1221.474  
 (PW+MO Day\_3) - (PW+MO Day\_7) 1.41132 0.0058211 Inf 242.448  
 (sterile-water Day\_5) - (PW-MO Day\_5) -1.00263 0.0006397 Inf -1567.370  
 (sterile-water Day\_5) - (PW+MO Day\_5) 3.54896 0.0030814 Inf 1151.754  
 (sterile-water Day\_5) - (sterile-water Day\_7) 0.87932 0.0009291 Inf 946.472  
 (sterile-water Day\_5) - (PW-MO Day\_7) -0.13775 0.0008046 Inf -171.196  
 (sterile-water Day\_5) - (PW+MO Day\_7) 4.72289 0.0051535 Inf 916.446  
 (PW-MO Day\_5) - (PW+MO Day\_5) 4.55159 0.0030565 Inf 1489.167  
 (PW-MO Day\_5) - (sterile-water Day\_7) 1.88195 0.0008429 Inf 2232.838  
 (PW-MO Day\_5) - (PW-MO Day\_7) 0.86488 0.0007033 Inf 1229.677  
 (PW-MO Day\_5) - (PW+MO Day\_7) 5.72552 0.0051386 Inf 1114.208  
 (PW+MO Day\_5) - (sterile-water Day\_7) -2.66963 0.0031298 Inf -852.962  
 (PW+MO Day\_5) - (PW-MO Day\_7) -3.68671 0.0030952 Inf -1191.109  
 (PW+MO Day\_5) - (PW+MO Day\_7) 1.17393 0.0059575 Inf 197.053  
 (sterile-water Day\_7) - (PW-MO Day\_7) -1.01707 0.0009740 Inf -1044.251  
 (sterile-water Day\_7) - (PW+MO Day\_7) 3.84357 0.0051826 Inf 741.626  
 (PW-MO Day\_7) - (PW+MO Day\_7) 4.86064 0.0051618 Inf 941.661  
 p.value  
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Results are averaged over the levels of: TB   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 12 estimates

plot(pairwise\_water\_treatment\_day\_2b)



# should I go for the cld letter comparisons for these? I think that may be the easiest to show

cld post hoc plots

library(multcompView)

# \*Publication figure

2a

fig\_2a <- eb\_pw %>%  
 # combine floating and adherent for total\_Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
   
 # create the plot  
 ggplot(aes(y= combined\_bd, x = filter, fill = filter)) +   
 geom\_boxplot() +  
 geom\_jitter(width = 0.2, alpha = 0.3) +  
 scale\_y\_log10() +  
 facet\_wrap(~day, labeller = labeller(day = c("Day\_1" = "Day 1",  
 "Day\_7" = "Day 7")))+  
   
 scale\_fill\_manual(values = c("40um\_filter" = with\_microbes\_40\_color,   
 "0.22um\_filter" = no\_microbes\_.22\_color)) +  
 myCustomTheme() +  
 theme(legend.position = "none",  
 strip.text = element\_text(face="bold"),  
 axis.title = element\_text(face = "bold")) +   
 scale\_x\_discrete (labels= c("40um\_filter" = "+ AE Microbes", "0.22um\_filter" = "- AE Microbes")) +  
 xlab("Presence of Microbes in Pond Water") +  
 ylab("Bd Quantity (ZE)") +  
   
 # add controls ad x's  
 geom\_point(data = eb\_pw\_controls, aes(x = filter, y = combined\_bd), shape = 4, size = 2)

2b

# Convert factor day to numeric while preserving original values  
pw\_noday0$day <- as.numeric(as.character(pw\_noday0$day))

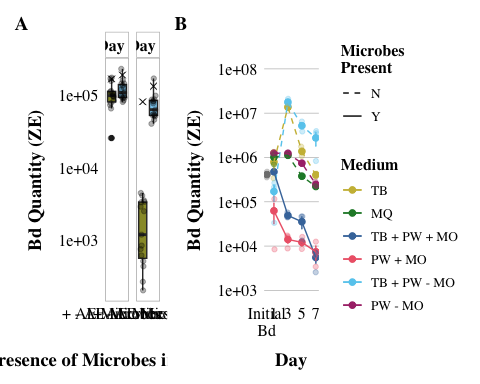
Warning: NAs introduced by coercion

fig2B <- pw\_summary %>%   
 # reorder to match Renwei's plot  
 mutate(sample\_ID = factor(sample\_ID,   
 levels = c("1%TB", "MQ", "1%TB+PW+microorganism", "PW+microorganism", "1%TB+PW-microorganism", "PW-microorganism", "Added Bd"))) %>%   
 mutate(day = as.numeric(day)) %>%   
 ggplot(aes(x = day\_numeric,   
 y = mean,   
 color = sample\_ID)) +  
 geom\_point(size = 2) +  
 geom\_errorbar(aes(ymin = mean - se, # plot the standard error  
 ymax = mean + se),  
 width = 0.1) +  
  
 # Adding the raw data as a layer with jitter  
 geom\_point(data = pw\_noday0,   
 aes(x = day\_numeric,   
 y = adh\_plus\_sup,   
 color = sample\_ID), # Raw data points  
 position = position\_jitter(width = 0.1, seed = 1),  
 alpha = 0.3) +  
 # add control raw data too  
 geom\_point(data = pw\_control\_data,   
 aes(x = day\_numeric,   
 y = adh\_plus\_sup,   
 color = "#BBBBBB"), # Raw data points  
 position = position\_jitter(width = 0.1, seed = 1),  
 alpha = 0.3) +  
   
 scale\_y\_log10(limits = c(1e3, 1e8),   
 breaks = c(1e3, 1e4, 1e5, 1e6, 1e7, 1e8)) +  
 labs(x = "Day",  
 y = "Bd Quantity (ZE)",  
 color = "Medium", # Title for color legend  
 linetype = "Microbes\nPresent" # Title for linetype legend  
 ) +  
 scale\_color\_manual(values = c("1%TB" = "#CCBB44",   
 "MQ" = "#228833",   
 "1%TB+PW+microorganism" = "#4477AA",   
 "PW+microorganism" = "#EE6677",   
 "1%TB+PW-microorganism" = "#66CCEE",  
 #"Added Bd" = "#BBBBBB" # removed bc not really a medium  
 "PW-microorganism" = "#AA3377"),   
 labels = c("1%TB" = "TB",  
 "MQ" = "MQ",  
 "1%TB+PW+microorganism" = "TB + PW + MO",  
 "PW+microorganism" = "PW + MO",  
 "1%TB+PW-microorganism" = "TB + PW - MO",  
 "PW-microorganism" = "PW - MO",  
 "Added Bd" = "Initial Bd")) + # Custom labels for the color legend  
   
 geom\_line(aes(linetype = microbes)) +   
 scale\_linetype\_manual(values = c("n" = "dashed",   
 "y" = "solid"),  
 labels = c("n" = "N", "y" = "Y")) + # Change labels to uppercase N and Y  
 myCustomTheme()+  
 scale\_x\_continuous(breaks = c(0, 1, 3, 5, 7),  
 labels = c("Initial\nBd", "1", "3", "5", "7")) +  
 theme(legend.position = "right",  
 panel.grid.major.y = element\_line(color = "grey"), # Add major y grid lines  
 panel.border = element\_blank())

Warning: There was 1 warning in `mutate()`.  
ℹ In argument: `day = as.numeric(day)`.  
Caused by warning:  
! NAs introduced by coercion

combine

# Combine fig\_2a and fig\_2b side by side  
fig2 <- fig\_2a + fig2B +   
 plot\_layout(widths = c(1, 1)) + # Ensure equal widths for both plots  
 plot\_annotation(tag\_levels = 'A') # Adds "A" and "B" to the upper corners  
  
fig2



#ggsave("2a\_2b.png", plot = fig2, width = 14, height = 5, dpi = 1000)

# \*SI figures and tables

## 2b anova table

# anova table  
anova\_output <- tidy(aov\_2b)  
  
aov\_2b\_tbl <- anova\_output %>%  
 dplyr::select(term, df, sumsq, meansq, statistic, p.value) %>%  
 gt() %>%  
 tab\_header(  
 title = "ANOVA Table"  
 ) %>%  
 fmt\_number(  
 columns = c(sumsq, meansq, statistic),  
 decimals = 2  
 ) %>%  
 cols\_label(  
 term = "Term",  
 df = "Df",  
 sumsq = "Sum Sq",  
 meansq = "Mean Sq",  
 statistic = "F value",  
 p.value = "P-value"  
 ) %>% # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 )  
aov\_2b\_tbl

Table 1: ANOVA Table

| Term | Df | Sum Sq | Mean Sq | F value | P-value |
| --- | --- | --- | --- | --- | --- |
| day | 3 | 35.40 | 11.80 | 45.61 | 4.3 × 10^-14 |
| TB | 1 | 20.99 | 20.99 | 81.13 | 6.9 × 10^-12 |
| water\_treatment | 2 | 228.85 | 114.42 | 442.25 | 1.2 × 10^-31 |
| day:TB | 3 | 11.71 | 3.90 | 15.08 | 4.8 × 10^-7 |
| day:water\_treatment | 6 | 37.33 | 6.22 | 24.05 | 6.4 × 10^-13 |
| TB:water\_treatment | 2 | 0.06 | 0.03 | 0.11 | 0.897 |
| day:TB:water\_treatment | 6 | 24.57 | 4.09 | 15.82 | 6.3 × 10^-10 |
| Residuals | 48 | 12.42 | 0.26 | NA | NA |

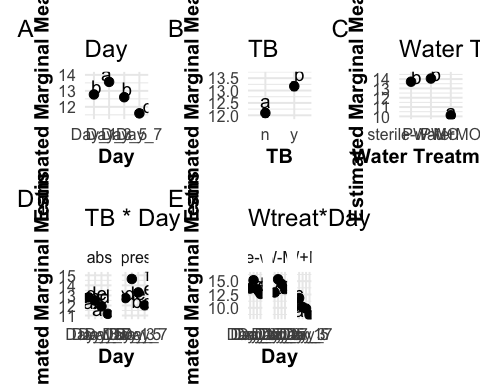
# prettier, simplified  
anova\_output <- tidy(aov\_2b)  
  
# Modify term to include degrees of freedom in \*italics\*  
anova\_output <- anova\_output %>%  
 mutate(term = ifelse(grepl("day:medium", term), "day x medium", term)) %>%   
 mutate (term = paste0(term, " (\*df = ", df, ", ", anova\_output[df == max(df), "df"], "\*)")) %>%   
 filter(term != "Residuals (\*df = 48, 48\*)")  
  
# Create the gt table with selected columns  
aov\_2b\_tbl\_b <- anova\_output %>%  
 dplyr::select(term, statistic, p.value) %>%  
 gt() %>%  
 tab\_header(  
 title = "ANOVA Table"  
 ) %>%  
 fmt\_markdown(  
 columns = c(term)  
 ) %>%  
 fmt\_number(  
 columns = c(statistic),  
 decimals = 2  
 ) %>%  
 cols\_label(  
 term = "",  
 statistic = "F value",  
 p.value = "P-value"  
 ) %>%  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 )  
  
aov\_2b\_tbl\_b

Table 1: ANOVA Table

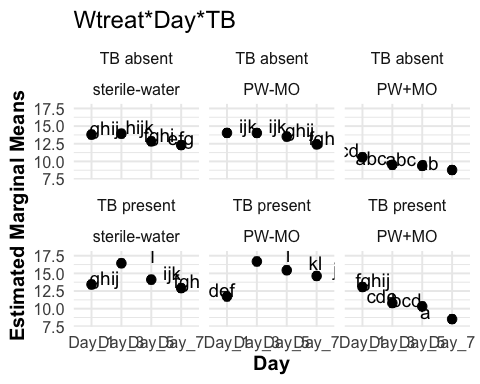
|  | F value | P-value |
| --- | --- | --- |
| day (*df = 3, 48*) | 45.61 | 4.3 × 10^-14 |
| TB (*df = 1, 48*) | 81.13 | 6.9 × 10^-12 |
| water\_treatment (*df = 2, 48*) | 442.25 | 1.2 × 10^-31 |
| day:TB (*df = 3, 48*) | 15.08 | 4.8 × 10^-7 |
| day:water\_treatment (*df = 6, 48*) | 24.05 | 6.4 × 10^-13 |
| TB:water\_treatment (*df = 2, 48*) | 0.11 | 0.897 |
| day:TB:water\_treatment (*df = 6, 48*) | 15.82 | 6.3 × 10^-10 |

## 2b cld plots

pairwise\_cld\_2b <- cld\_day\_2b + cld\_TB\_2b + cld\_water\_treatment\_2b + cld\_tb\_day\_int\_2b + cld\_watertreat\_day\_int\_2b +  
 plot\_annotation(tag\_levels = 'A')  
  
# Display the combined plot  
pairwise\_cld\_2b



#ggsave("2b\_pairwise\_cld.png", plot = pairwise\_cld\_2b, width = 14, height = 8, dpi = 1000)  
  
cld\_water\_thirdorder\_2b



#ggsave("2b\_thirdorder\_pairwise\_cld.png", plot = cld\_water\_thirdorder\_2b , width = 14, height = 8, dpi = 1000)

## 2b posthoc table

We likely will not include this, but if we need to find these specific t and p values we can locate them here

ph\_2b\_day\_df <- as.data.frame(ph\_2b\_day)  
ph\_2b\_TB\_df <- as.data.frame(ph\_2b\_TB)  
ph\_2b\_water\_treatment\_df <- as.data.frame(ph\_2b\_water\_treatment)  
ph\_2b\_water\_treatment\_day\_df <- as.data.frame(ph\_2b\_water\_treatment\_day)  
ph\_2b\_day\_TB\_df <- as.data.frame(ph\_2b\_day\_TB)  
   
ph\_2b\_day\_df <- ph\_2b\_day\_df %>% mutate(factor = "Day")  
ph\_2b\_TB\_df <- ph\_2b\_TB\_df %>% mutate(factor = "TB")  
ph\_2b\_water\_treatment\_df <- ph\_2b\_water\_treatment\_df %>% mutate(factor = "WTreat")  
ph\_2b\_water\_treatment\_day\_df <- ph\_2b\_water\_treatment\_day\_df %>% mutate(factor = "Day\*WTreat")  
ph\_2b\_day\_TB\_df <- ph\_2b\_day\_TB\_df %>% mutate(factor = "Day\*TB")  
  
# combine all pairwise comparisons  
f2b\_all\_tukey\_df <- bind\_rows(ph\_2b\_day\_df, ph\_2b\_TB\_df, ph\_2b\_water\_treatment\_df, ph\_2b\_water\_treatment\_day\_df, ph\_2b\_day\_TB\_df)  
  
f2b\_all\_tukey\_df

contrast estimate SE df  
1 Day\_1 - Day\_3 -0.78783861 0.1695522 48  
2 Day\_1 - Day\_5 0.17150692 0.1695522 48  
3 Day\_1 - Day\_7 1.18175034 0.1695522 48  
4 Day\_3 - Day\_5 0.95934552 0.1695522 48  
5 Day\_3 - Day\_7 1.96958894 0.1695522 48  
6 Day\_5 - Day\_7 1.01024342 0.1695522 48  
7 n - y -1.07987165 0.1198915 48  
8 (sterile-water) - (PW-MO) -0.34028396 0.1468365 48  
9 (sterile-water) - (PW+MO) 3.60029322 0.1468365 48  
10 (PW-MO) - (PW+MO) 3.94057719 0.1468365 48  
11 (sterile-water Day\_1) - (PW-MO Day\_1) 0.73277523 0.2936731 48  
12 (sterile-water Day\_1) - (PW+MO Day\_1) 1.78762409 0.2936731 48  
13 (sterile-water Day\_1) - (sterile-water Day\_3) -1.56409952 0.2936731 48  
14 (sterile-water Day\_1) - (PW-MO Day\_3) -1.74122159 0.2936731 48  
15 (sterile-water Day\_1) - (PW+MO Day\_3) 3.46220461 0.2936731 48  
16 (sterile-water Day\_1) - (sterile-water Day\_5) 0.13666277 0.2936731 48  
17 (sterile-water Day\_1) - (PW-MO Day\_5) -0.86539619 0.2936731 48  
18 (sterile-water Day\_1) - (PW+MO Day\_5) 3.76365348 0.2936731 48  
19 (sterile-water Day\_1) - (sterile-water Day\_7) 1.00670881 0.2936731 48  
20 (sterile-water Day\_1) - (PW-MO Day\_7) 0.09197876 0.2936731 48  
21 (sterile-water Day\_1) - (PW+MO Day\_7) 4.96696276 0.2936731 48  
22 (PW-MO Day\_1) - (PW+MO Day\_1) 1.05484887 0.2936731 48  
23 (PW-MO Day\_1) - (sterile-water Day\_3) -2.29687475 0.2936731 48  
24 (PW-MO Day\_1) - (PW-MO Day\_3) -2.47399681 0.2936731 48  
25 (PW-MO Day\_1) - (PW+MO Day\_3) 2.72942939 0.2936731 48  
26 (PW-MO Day\_1) - (sterile-water Day\_5) -0.59611245 0.2936731 48  
27 (PW-MO Day\_1) - (PW-MO Day\_5) -1.59817142 0.2936731 48  
28 (PW-MO Day\_1) - (PW+MO Day\_5) 3.03087826 0.2936731 48  
29 (PW-MO Day\_1) - (sterile-water Day\_7) 0.27393358 0.2936731 48  
30 (PW-MO Day\_1) - (PW-MO Day\_7) -0.64079647 0.2936731 48  
31 (PW-MO Day\_1) - (PW+MO Day\_7) 4.23418754 0.2936731 48  
32 (PW+MO Day\_1) - (sterile-water Day\_3) -3.35172362 0.2936731 48  
33 (PW+MO Day\_1) - (PW-MO Day\_3) -3.52884568 0.2936731 48  
34 (PW+MO Day\_1) - (PW+MO Day\_3) 1.67458052 0.2936731 48  
35 (PW+MO Day\_1) - (sterile-water Day\_5) -1.65096132 0.2936731 48  
36 (PW+MO Day\_1) - (PW-MO Day\_5) -2.65302028 0.2936731 48  
37 (PW+MO Day\_1) - (PW+MO Day\_5) 1.97602939 0.2936731 48  
38 (PW+MO Day\_1) - (sterile-water Day\_7) -0.78091529 0.2936731 48  
39 (PW+MO Day\_1) - (PW-MO Day\_7) -1.69564533 0.2936731 48  
40 (PW+MO Day\_1) - (PW+MO Day\_7) 3.17933867 0.2936731 48  
41 (sterile-water Day\_3) - (PW-MO Day\_3) -0.17712206 0.2936731 48  
42 (sterile-water Day\_3) - (PW+MO Day\_3) 5.02630414 0.2936731 48  
43 (sterile-water Day\_3) - (sterile-water Day\_5) 1.70076230 0.2936731 48  
44 (sterile-water Day\_3) - (PW-MO Day\_5) 0.69870333 0.2936731 48  
45 (sterile-water Day\_3) - (PW+MO Day\_5) 5.32775301 0.2936731 48  
46 (sterile-water Day\_3) - (sterile-water Day\_7) 2.57080833 0.2936731 48  
47 (sterile-water Day\_3) - (PW-MO Day\_7) 1.65607828 0.2936731 48  
48 (sterile-water Day\_3) - (PW+MO Day\_7) 6.53106229 0.2936731 48  
49 (PW-MO Day\_3) - (PW+MO Day\_3) 5.20342620 0.2936731 48  
50 (PW-MO Day\_3) - (sterile-water Day\_5) 1.87788436 0.2936731 48  
51 (PW-MO Day\_3) - (PW-MO Day\_5) 0.87582540 0.2936731 48  
52 (PW-MO Day\_3) - (PW+MO Day\_5) 5.50487507 0.2936731 48  
53 (PW-MO Day\_3) - (sterile-water Day\_7) 2.74793039 0.2936731 48  
54 (PW-MO Day\_3) - (PW-MO Day\_7) 1.83320035 0.2936731 48  
55 (PW-MO Day\_3) - (PW+MO Day\_7) 6.70818435 0.2936731 48  
56 (PW+MO Day\_3) - (sterile-water Day\_5) -3.32554184 0.2936731 48  
57 (PW+MO Day\_3) - (PW-MO Day\_5) -4.32760080 0.2936731 48  
58 (PW+MO Day\_3) - (PW+MO Day\_5) 0.30144887 0.2936731 48  
59 (PW+MO Day\_3) - (sterile-water Day\_7) -2.45549581 0.2936731 48  
60 (PW+MO Day\_3) - (PW-MO Day\_7) -3.37022585 0.2936731 48  
61 (PW+MO Day\_3) - (PW+MO Day\_7) 1.50475815 0.2936731 48  
62 (sterile-water Day\_5) - (PW-MO Day\_5) -1.00205896 0.2936731 48  
63 (sterile-water Day\_5) - (PW+MO Day\_5) 3.62699071 0.2936731 48  
64 (sterile-water Day\_5) - (sterile-water Day\_7) 0.87004603 0.2936731 48  
65 (sterile-water Day\_5) - (PW-MO Day\_7) -0.04468401 0.2936731 48  
66 (sterile-water Day\_5) - (PW+MO Day\_7) 4.83029999 0.2936731 48  
67 (PW-MO Day\_5) - (PW+MO Day\_5) 4.62904968 0.2936731 48  
68 (PW-MO Day\_5) - (sterile-water Day\_7) 1.87210500 0.2936731 48  
69 (PW-MO Day\_5) - (PW-MO Day\_7) 0.95737495 0.2936731 48  
70 (PW-MO Day\_5) - (PW+MO Day\_7) 5.83235895 0.2936731 48  
71 (PW+MO Day\_5) - (sterile-water Day\_7) -2.75694468 0.2936731 48  
72 (PW+MO Day\_5) - (PW-MO Day\_7) -3.67167472 0.2936731 48  
73 (PW+MO Day\_5) - (PW+MO Day\_7) 1.20330928 0.2936731 48  
74 (sterile-water Day\_7) - (PW-MO Day\_7) -0.91473005 0.2936731 48  
75 (sterile-water Day\_7) - (PW+MO Day\_7) 3.96025396 0.2936731 48  
76 (PW-MO Day\_7) - (PW+MO Day\_7) 4.87498400 0.2936731 48  
77 n Day\_1 - y Day\_1 0.06776878 0.2397830 48  
78 n Day\_1 - n Day\_3 0.31984147 0.2397830 48  
79 n Day\_1 - y Day\_3 -1.82774990 0.2397830 48  
80 n Day\_1 - n Day\_5 0.89827967 0.2397830 48  
81 n Day\_1 - y Day\_5 -0.48749705 0.2397830 48  
82 n Day\_1 - n Day\_7 1.64257839 0.2397830 48  
83 n Day\_1 - y Day\_7 0.78869107 0.2397830 48  
84 y Day\_1 - n Day\_3 0.25207268 0.2397830 48  
85 y Day\_1 - y Day\_3 -1.89551868 0.2397830 48  
86 y Day\_1 - n Day\_5 0.83051089 0.2397830 48  
87 y Day\_1 - y Day\_5 -0.55526584 0.2397830 48  
88 y Day\_1 - n Day\_7 1.57480960 0.2397830 48  
89 y Day\_1 - y Day\_7 0.72092229 0.2397830 48  
90 n Day\_3 - y Day\_3 -2.14759136 0.2397830 48  
91 n Day\_3 - n Day\_5 0.57843820 0.2397830 48  
92 n Day\_3 - y Day\_5 -0.80733852 0.2397830 48  
93 n Day\_3 - n Day\_7 1.32273692 0.2397830 48  
94 n Day\_3 - y Day\_7 0.46884960 0.2397830 48  
95 y Day\_3 - n Day\_5 2.72602956 0.2397830 48  
96 y Day\_3 - y Day\_5 1.34025284 0.2397830 48  
97 y Day\_3 - n Day\_7 3.47032828 0.2397830 48  
98 y Day\_3 - y Day\_7 2.61644097 0.2397830 48  
99 n Day\_5 - y Day\_5 -1.38577672 0.2397830 48  
100 n Day\_5 - n Day\_7 0.74429872 0.2397830 48  
101 n Day\_5 - y Day\_7 -0.10958860 0.2397830 48  
102 y Day\_5 - n Day\_7 2.13007544 0.2397830 48  
103 y Day\_5 - y Day\_7 1.27618812 0.2397830 48  
104 n Day\_7 - y Day\_7 -0.85388732 0.2397830 48  
 t.ratio p.value factor  
1 -4.6465838 1.521359e-04 Day  
2 1.0115286 7.434984e-01 Day  
3 6.9698311 4.856333e-08 Day  
4 5.6581124 4.873649e-06 Day  
5 11.6164149 0.000000e+00 Day  
6 5.9583025 1.709576e-06 Day  
7 -9.0070725 6.923623e-12 TB  
8 -2.3174340 6.290873e-02 WTreat  
9 24.5190568 0.000000e+00 WTreat  
10 26.8364907 0.000000e+00 WTreat  
11 2.4952075 3.673389e-01 Day\*WTreat  
12 6.0871232 1.129690e-05 Day\*WTreat  
13 -5.3259891 1.540442e-04 Day\*WTreat  
14 -5.9291158 1.954465e-05 Day\*WTreat  
15 11.7893163 0.000000e+00 Day\*WTreat  
16 0.4653569 9.999983e-01 Day\*WTreat  
17 -2.9468014 1.573217e-01 Day\*WTreat  
18 12.8157941 0.000000e+00 Day\*WTreat  
19 3.4279917 5.073938e-02 Day\*WTreat  
20 0.3132012 1.000000e+00 Day\*WTreat  
21 16.9132393 0.000000e+00 Day\*WTreat  
22 3.5919157 3.304508e-02 Day\*WTreat  
23 -7.8211966 2.627077e-08 Day\*WTreat  
24 -8.4243233 3.262514e-09 Day\*WTreat  
25 9.2941088 1.677356e-10 Day\*WTreat  
26 -2.0298507 6.716810e-01 Day\*WTreat  
27 -5.4420089 1.040033e-04 Day\*WTreat  
28 10.3205866 2.958744e-12 Day\*WTreat  
29 0.9327842 9.983727e-01 Day\*WTreat  
30 -2.1820063 5.697876e-01 Day\*WTreat  
31 14.4180318 0.000000e+00 Day\*WTreat  
32 -11.4131123 0.000000e+00 Day\*WTreat  
33 -12.0162390 0.000000e+00 Day\*WTreat  
34 5.7021932 4.275279e-05 Day\*WTreat  
35 -5.6217663 5.633470e-05 Day\*WTreat  
36 -9.0339246 4.064197e-10 Day\*WTreat  
37 6.7286710 1.200472e-06 Day\*WTreat  
38 -2.6591315 2.775082e-01 Day\*WTreat  
39 -5.7739220 3.340389e-05 Day\*WTreat  
40 10.8261162 0.000000e+00 Day\*WTreat  
41 -0.6031267 9.999751e-01 Day\*WTreat  
42 17.1153055 0.000000e+00 Day\*WTreat  
43 5.7913460 3.145739e-05 Day\*WTreat  
44 2.3791877 4.388765e-01 Day\*WTreat  
45 18.1417832 0.000000e+00 Day\*WTreat  
46 8.7539808 1.054727e-09 Day\*WTreat  
47 5.6391903 5.307043e-05 Day\*WTreat  
48 22.2392285 0.000000e+00 Day\*WTreat  
49 17.7184322 0.000000e+00 Day\*WTreat  
50 6.3944727 3.868566e-06 Day\*WTreat  
51 2.9823144 1.457799e-01 Day\*WTreat  
52 18.7449099 0.000000e+00 Day\*WTreat  
53 9.3571075 1.353071e-10 Day\*WTreat  
54 6.2423170 6.580768e-06 Day\*WTreat  
55 22.8423552 0.000000e+00 Day\*WTreat  
56 -11.3239595 0.000000e+00 Day\*WTreat  
57 -14.7361178 0.000000e+00 Day\*WTreat  
58 1.0264778 9.962387e-01 Day\*WTreat  
59 -8.3613247 4.051934e-09 Day\*WTreat  
60 -11.4761151 0.000000e+00 Day\*WTreat  
61 5.1239230 3.033969e-04 Day\*WTreat  
62 -3.4121583 5.282930e-02 Day\*WTreat  
63 12.3504373 0.000000e+00 Day\*WTreat  
64 2.9626348 1.520910e-01 Day\*WTreat  
65 -0.1521556 1.000000e+00 Day\*WTreat  
66 16.4478825 0.000000e+00 Day\*WTreat  
67 15.7625955 0.000000e+00 Day\*WTreat  
68 6.3747931 4.144016e-06 Day\*WTreat  
69 3.2600026 7.707520e-02 Day\*WTreat  
70 19.8600408 0.000000e+00 Day\*WTreat  
71 -9.3878025 1.218505e-10 Day\*WTreat  
72 -12.5025929 0.000000e+00 Day\*WTreat  
73 4.0974452 7.896020e-03 Day\*WTreat  
74 -3.1147905 1.085209e-01 Day\*WTreat  
75 13.4852477 0.000000e+00 Day\*WTreat  
76 16.6000381 0.000000e+00 Day\*WTreat  
77 0.2826254 9.999917e-01 Day\*TB  
78 1.3338786 8.811923e-01 Day\*TB  
79 -7.6225150 2.254691e-08 Day\*TB  
80 3.7462184 1.049517e-02 Day\*TB  
81 -2.0330755 4.714340e-01 Day\*TB  
82 6.8502690 3.385799e-07 Day\*TB  
83 3.2891861 3.673700e-02 Day\*TB  
84 1.0512531 9.635870e-01 Day\*TB  
85 -7.9051404 8.416364e-09 Day\*TB  
86 3.4635930 2.312956e-02 Day\*TB  
87 -2.3157010 3.066017e-01 Day\*TB  
88 6.5676436 9.143272e-07 Day\*TB  
89 3.0065607 7.421067e-02 Day\*TB  
90 -8.9563936 2.244819e-10 Day\*TB  
91 2.4123398 2.589734e-01 Day\*TB  
92 -3.3669541 2.996437e-02 Day\*TB  
93 5.5163904 3.559339e-05 Day\*TB  
94 1.9553075 5.214920e-01 Day\*TB  
95 11.3687334 0.000000e+00 Day\*TB  
96 5.5894395 2.768988e-05 Day\*TB  
97 14.4727840 0.000000e+00 Day\*TB  
98 10.9117011 0.000000e+00 Day\*TB  
99 -5.7792939 1.437258e-05 Day\*TB  
100 3.1040506 5.863526e-02 Day\*TB  
101 -0.4570323 9.997851e-01 Day\*TB  
102 8.8833445 2.883955e-10 Day\*TB  
103 5.3222616 6.910324e-05 Day\*TB  
104 -3.5610829 1.770574e-02 Day\*TB

ph2b\_table <- f2b\_all\_tukey\_df %>%  
 dplyr::select(factor, contrast, estimate, SE, df, t.ratio, p.value) %>%  
 gt() %>%  
 # change column names  
 cols\_label(  
 factor = "Comparison",  
 contrast = "Group Comparison",  
 estimate = "Estimate",  
 SE = "Standard Error",  
 df = "Degrees of Freedom",  
 t.ratio = "t-Ratio",  
 p.value = "p-value"  
 ) %>%  
 # update header for table  
 tab\_header(  
 title = "4b Emmeans Post-hoc Test Results"  
 ) %>%  
 # 3 decimal places  
 fmt\_number(  
 columns = c(estimate, SE, t.ratio),  
 decimals = 3  
 ) %>%  
 # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 ) %>%  
 #make the headers bold  
 tab\_style(  
 style = list(  
 cell\_text(weight = "bold")  
 ),  
 locations = cells\_column\_labels(everything()))  
  
ph2b\_table

Table 1: 4b Emmeans Post-hoc Test Results

| Comparison | Group Comparison | Estimate | Standard Error | Degrees of Freedom | t-Ratio | p-value |
| --- | --- | --- | --- | --- | --- | --- |
| Day | Day\_1 - Day\_3 | -0.788 | 0.170 | 48 | -4.647 | 1.5 × 10^-4 |
| Day | Day\_1 - Day\_5 | 0.172 | 0.170 | 48 | 1.012 | 0.743 |
| Day | Day\_1 - Day\_7 | 1.182 | 0.170 | 48 | 6.970 | 4.9 × 10^-8 |
| Day | Day\_3 - Day\_5 | 0.959 | 0.170 | 48 | 5.658 | 4.9 × 10^-6 |
| Day | Day\_3 - Day\_7 | 1.970 | 0.170 | 48 | 11.616 | 0.0 |
| Day | Day\_5 - Day\_7 | 1.010 | 0.170 | 48 | 5.958 | 1.7 × 10^-6 |
| TB | n - y | -1.080 | 0.120 | 48 | -9.007 | 6.9 × 10^-12 |
| WTreat | (sterile-water) - (PW-MO) | -0.340 | 0.147 | 48 | -2.317 | 0.063 |
| WTreat | (sterile-water) - (PW+MO) | 3.600 | 0.147 | 48 | 24.519 | 0.0 |
| WTreat | (PW-MO) - (PW+MO) | 3.941 | 0.147 | 48 | 26.836 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_1) | 0.733 | 0.294 | 48 | 2.495 | 0.367 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_1) | 1.788 | 0.294 | 48 | 6.087 | 1.1 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_3) | -1.564 | 0.294 | 48 | -5.326 | 1.5 × 10^-4 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_3) | -1.741 | 0.294 | 48 | -5.929 | 2.0 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_3) | 3.462 | 0.294 | 48 | 11.789 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_5) | 0.137 | 0.294 | 48 | 0.465 | 1.000 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_5) | -0.865 | 0.294 | 48 | -2.947 | 0.157 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_5) | 3.764 | 0.294 | 48 | 12.816 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_7) | 1.007 | 0.294 | 48 | 3.428 | 0.051 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_7) | 0.092 | 0.294 | 48 | 0.313 | 1.000 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_7) | 4.967 | 0.294 | 48 | 16.913 | 0.0 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_1) | 1.055 | 0.294 | 48 | 3.592 | 0.033 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_3) | -2.297 | 0.294 | 48 | -7.821 | 2.6 × 10^-8 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_3) | -2.474 | 0.294 | 48 | -8.424 | 3.3 × 10^-9 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_3) | 2.729 | 0.294 | 48 | 9.294 | 1.7 × 10^-10 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_5) | -0.596 | 0.294 | 48 | -2.030 | 0.672 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_5) | -1.598 | 0.294 | 48 | -5.442 | 1.0 × 10^-4 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_5) | 3.031 | 0.294 | 48 | 10.321 | 3.0 × 10^-12 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_7) | 0.274 | 0.294 | 48 | 0.933 | 0.998 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_7) | -0.641 | 0.294 | 48 | -2.182 | 0.570 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_7) | 4.234 | 0.294 | 48 | 14.418 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_3) | -3.352 | 0.294 | 48 | -11.413 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_3) | -3.529 | 0.294 | 48 | -12.016 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_3) | 1.675 | 0.294 | 48 | 5.702 | 4.3 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_5) | -1.651 | 0.294 | 48 | -5.622 | 5.6 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_5) | -2.653 | 0.294 | 48 | -9.034 | 4.1 × 10^-10 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_5) | 1.976 | 0.294 | 48 | 6.729 | 1.2 × 10^-6 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_7) | -0.781 | 0.294 | 48 | -2.659 | 0.278 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_7) | -1.696 | 0.294 | 48 | -5.774 | 3.3 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_7) | 3.179 | 0.294 | 48 | 10.826 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_3) | -0.177 | 0.294 | 48 | -0.603 | 1.000 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_3) | 5.026 | 0.294 | 48 | 17.115 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (sterile-water Day\_5) | 1.701 | 0.294 | 48 | 5.791 | 3.1 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_5) | 0.699 | 0.294 | 48 | 2.379 | 0.439 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_5) | 5.328 | 0.294 | 48 | 18.142 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (sterile-water Day\_7) | 2.571 | 0.294 | 48 | 8.754 | 1.1 × 10^-9 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_7) | 1.656 | 0.294 | 48 | 5.639 | 5.3 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_7) | 6.531 | 0.294 | 48 | 22.239 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_3) | 5.203 | 0.294 | 48 | 17.718 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (sterile-water Day\_5) | 1.878 | 0.294 | 48 | 6.394 | 3.9 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_3) - (PW-MO Day\_5) | 0.876 | 0.294 | 48 | 2.982 | 0.146 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_5) | 5.505 | 0.294 | 48 | 18.745 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (sterile-water Day\_7) | 2.748 | 0.294 | 48 | 9.357 | 1.4 × 10^-10 |
| Day\*WTreat | (PW-MO Day\_3) - (PW-MO Day\_7) | 1.833 | 0.294 | 48 | 6.242 | 6.6 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_7) | 6.708 | 0.294 | 48 | 22.842 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (sterile-water Day\_5) | -3.326 | 0.294 | 48 | -11.324 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW-MO Day\_5) | -4.328 | 0.294 | 48 | -14.736 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW+MO Day\_5) | 0.301 | 0.294 | 48 | 1.026 | 0.996 |
| Day\*WTreat | (PW+MO Day\_3) - (sterile-water Day\_7) | -2.455 | 0.294 | 48 | -8.361 | 4.1 × 10^-9 |
| Day\*WTreat | (PW+MO Day\_3) - (PW-MO Day\_7) | -3.370 | 0.294 | 48 | -11.476 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW+MO Day\_7) | 1.505 | 0.294 | 48 | 5.124 | 3.0 × 10^-4 |
| Day\*WTreat | (sterile-water Day\_5) - (PW-MO Day\_5) | -1.002 | 0.294 | 48 | -3.412 | 0.053 |
| Day\*WTreat | (sterile-water Day\_5) - (PW+MO Day\_5) | 3.627 | 0.294 | 48 | 12.350 | 0.0 |
| Day\*WTreat | (sterile-water Day\_5) - (sterile-water Day\_7) | 0.870 | 0.294 | 48 | 2.963 | 0.152 |
| Day\*WTreat | (sterile-water Day\_5) - (PW-MO Day\_7) | -0.045 | 0.294 | 48 | -0.152 | 1.000 |
| Day\*WTreat | (sterile-water Day\_5) - (PW+MO Day\_7) | 4.830 | 0.294 | 48 | 16.448 | 0.0 |
| Day\*WTreat | (PW-MO Day\_5) - (PW+MO Day\_5) | 4.629 | 0.294 | 48 | 15.763 | 0.0 |
| Day\*WTreat | (PW-MO Day\_5) - (sterile-water Day\_7) | 1.872 | 0.294 | 48 | 6.375 | 4.1 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_5) - (PW-MO Day\_7) | 0.957 | 0.294 | 48 | 3.260 | 0.077 |
| Day\*WTreat | (PW-MO Day\_5) - (PW+MO Day\_7) | 5.832 | 0.294 | 48 | 19.860 | 0.0 |
| Day\*WTreat | (PW+MO Day\_5) - (sterile-water Day\_7) | -2.757 | 0.294 | 48 | -9.388 | 1.2 × 10^-10 |
| Day\*WTreat | (PW+MO Day\_5) - (PW-MO Day\_7) | -3.672 | 0.294 | 48 | -12.503 | 0.0 |
| Day\*WTreat | (PW+MO Day\_5) - (PW+MO Day\_7) | 1.203 | 0.294 | 48 | 4.097 | 0.008 |
| Day\*WTreat | (sterile-water Day\_7) - (PW-MO Day\_7) | -0.915 | 0.294 | 48 | -3.115 | 0.109 |
| Day\*WTreat | (sterile-water Day\_7) - (PW+MO Day\_7) | 3.960 | 0.294 | 48 | 13.485 | 0.0 |
| Day\*WTreat | (PW-MO Day\_7) - (PW+MO Day\_7) | 4.875 | 0.294 | 48 | 16.600 | 0.0 |
| Day\*TB | n Day\_1 - y Day\_1 | 0.068 | 0.240 | 48 | 0.283 | 1.000 |
| Day\*TB | n Day\_1 - n Day\_3 | 0.320 | 0.240 | 48 | 1.334 | 0.881 |
| Day\*TB | n Day\_1 - y Day\_3 | -1.828 | 0.240 | 48 | -7.623 | 2.3 × 10^-8 |
| Day\*TB | n Day\_1 - n Day\_5 | 0.898 | 0.240 | 48 | 3.746 | 0.010 |
| Day\*TB | n Day\_1 - y Day\_5 | -0.487 | 0.240 | 48 | -2.033 | 0.471 |
| Day\*TB | n Day\_1 - n Day\_7 | 1.643 | 0.240 | 48 | 6.850 | 3.4 × 10^-7 |
| Day\*TB | n Day\_1 - y Day\_7 | 0.789 | 0.240 | 48 | 3.289 | 0.037 |
| Day\*TB | y Day\_1 - n Day\_3 | 0.252 | 0.240 | 48 | 1.051 | 0.964 |
| Day\*TB | y Day\_1 - y Day\_3 | -1.896 | 0.240 | 48 | -7.905 | 8.4 × 10^-9 |
| Day\*TB | y Day\_1 - n Day\_5 | 0.831 | 0.240 | 48 | 3.464 | 0.023 |
| Day\*TB | y Day\_1 - y Day\_5 | -0.555 | 0.240 | 48 | -2.316 | 0.307 |
| Day\*TB | y Day\_1 - n Day\_7 | 1.575 | 0.240 | 48 | 6.568 | 9.1 × 10^-7 |
| Day\*TB | y Day\_1 - y Day\_7 | 0.721 | 0.240 | 48 | 3.007 | 0.074 |
| Day\*TB | n Day\_3 - y Day\_3 | -2.148 | 0.240 | 48 | -8.956 | 2.2 × 10^-10 |
| Day\*TB | n Day\_3 - n Day\_5 | 0.578 | 0.240 | 48 | 2.412 | 0.259 |
| Day\*TB | n Day\_3 - y Day\_5 | -0.807 | 0.240 | 48 | -3.367 | 0.030 |
| Day\*TB | n Day\_3 - n Day\_7 | 1.323 | 0.240 | 48 | 5.516 | 3.6 × 10^-5 |
| Day\*TB | n Day\_3 - y Day\_7 | 0.469 | 0.240 | 48 | 1.955 | 0.521 |
| Day\*TB | y Day\_3 - n Day\_5 | 2.726 | 0.240 | 48 | 11.369 | 0.0 |
| Day\*TB | y Day\_3 - y Day\_5 | 1.340 | 0.240 | 48 | 5.589 | 2.8 × 10^-5 |
| Day\*TB | y Day\_3 - n Day\_7 | 3.470 | 0.240 | 48 | 14.473 | 0.0 |
| Day\*TB | y Day\_3 - y Day\_7 | 2.616 | 0.240 | 48 | 10.912 | 0.0 |
| Day\*TB | n Day\_5 - y Day\_5 | -1.386 | 0.240 | 48 | -5.779 | 1.4 × 10^-5 |
| Day\*TB | n Day\_5 - n Day\_7 | 0.744 | 0.240 | 48 | 3.104 | 0.059 |
| Day\*TB | n Day\_5 - y Day\_7 | -0.110 | 0.240 | 48 | -0.457 | 1.000 |
| Day\*TB | y Day\_5 - n Day\_7 | 2.130 | 0.240 | 48 | 8.883 | 2.9 × 10^-10 |
| Day\*TB | y Day\_5 - y Day\_7 | 1.276 | 0.240 | 48 | 5.322 | 6.9 × 10^-5 |
| Day\*TB | n Day\_7 - y Day\_7 | -0.854 | 0.240 | 48 | -3.561 | 0.018 |

# Appendix

## ordered or unordered factor 2b