Project Test

Joan Moreaux

07/11/2021

```
library(DHARMa)
library(mgcv)
library(fitdistrplus)
library(goft)
library(gamlss)
library(FSA)
library(fGarch)
library(LambertW)
library(ordinal)
library(tidyverse)
```

```
health_data <- read.csv("Big_Data_Green.csv")
heat_data <- read.csv("Heat_Data.csv")
```

Health Data

Includes feeding time, PAM measurements, base measurements, and symbiont density

```
health_data <- health_data %>%
  mutate(Fv_Fm_1 = as.numeric(Fv_Fm_1), PAM_avg = ((Fv_Fm_1 + Fv_Fm_2 + Fv_Fm_3)/3)) %>%
  mutate(Base_Diameter_mm = (Base_Width + Base_Length + Base_Diagonal)/3) %>%
  mutate(Green_Density = (Green_Cells/1)*(1/0.1)*(1/0.001)*(0.5/Weight_Tentacle_g)) %>%
  mutate(Dino_Density = (Dino_Cells/1)*(1/0.1)*(1/0.001)*(0.5/Weight_Tentacle_g)) %>%
  mutate(Bucket = as.factor(Bucket), Treatment = as.factor(Treatment), Event = as.factor(Event),
         Species_ID = as.factor(Species_ID), Field_Site = as.factor(Field_Site))
```

PAM data

```
shapiro.test(health_data$PAM_avg) # p-value < 0.05, distribution is not normal
```

```
##
##  Shapiro-Wilk normality test
##
## data:  health_data$PAM_avg
## W = 0.84403, p-value < 2.2e-16
```

```r
bartlett.test(PAM_avg ~ Treatment, data = health_data) # p-value < 0.05, does not meet equal variance a
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  PAM_avg by Treatment
## Bartlett's K-squared = 60.318, df = 3, p-value = 5.028e-13
```

Checking distribution: If we get get a p-value < 0.5, then they are significantly different and we should not test

```r
exp_test(health_data$PAM_avg)        #p-value < 2.2e-16, cannot use
```

```
##
##  Test for exponentiality based on a transformation to uniformity
##
## data:  health_data$PAM_avg
## T = -16.079, p-value < 2.2e-16
```

```r
gamma_test(health_data$PAM_avg)      #p-value < 2.2e-16, cannot use
```

```
##
##  Test of fit for the Gamma distribution
##
## data:  health_data$PAM_avg
## V = -14.462, p-value < 2.2e-16
```

```r
lnorm_test(health_data$PAM_avg)      #p-value < 2.2e-16, cannot use
```

```
##
##  Test for the lognormal distribution based on a transformation to
##  normality
##
## data:  health_data$PAM_avg
## p-value < 2.2e-16
```

```r
normal_test(health_data$PAM_avg)     #p-value = 5.414e-08, cannot use
```

```
##
##  Correlation test for normality
##
## data:  health_data$PAM_avg
## R = 0.96852, p-value = 3.41e-08
## alternative hypothesis: health_data$PAM_avg does not follow a normal distribution.
```

```r
weibull_test(health_data$PAM_avg)    #p-value < 2.2e-16, cannot use
```

```
##
##  Test for the Weibull distribution
##
## data:  health_data$PAM_avg
## p-value < 2.2e-16
```

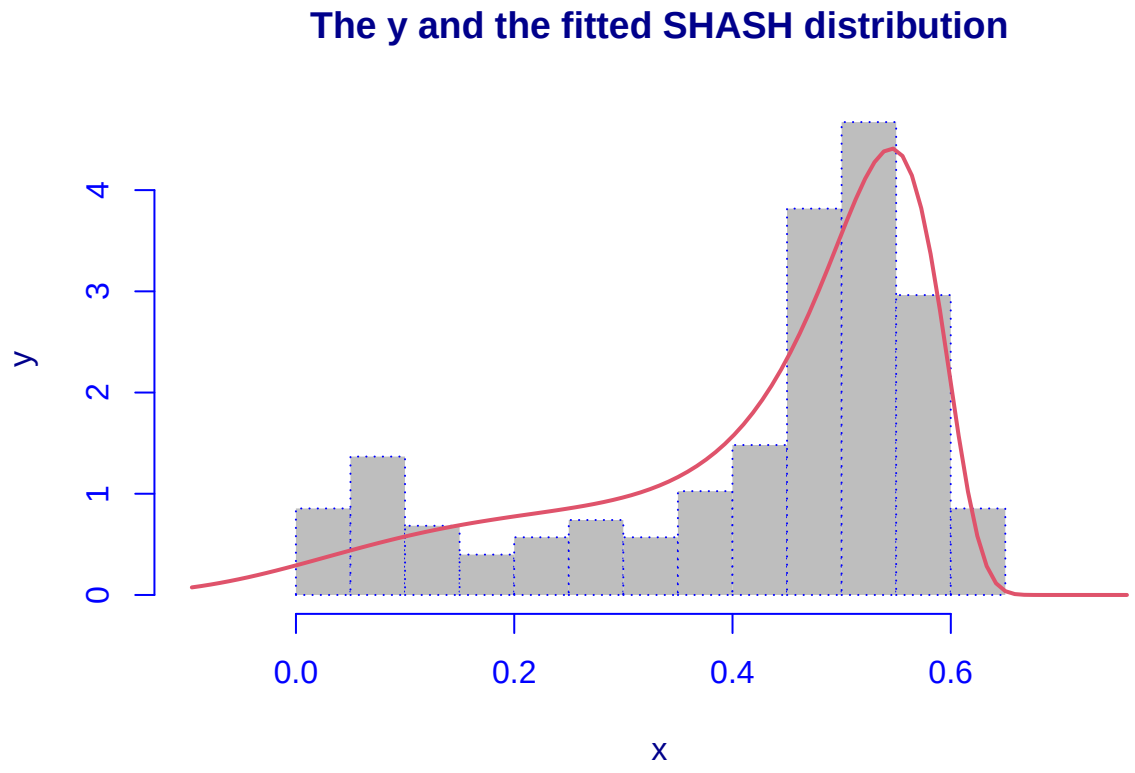
```
PAM_visual <- fitDist(PAM_avg, data = health_data, type = "realAll", try.gamlss = T)
```

```
##   |                                                                      |
##   Lapack routine dgesv: system is exactly singular: U[3,3] = 0
##   |                                                                      |==========
```

```
# Family:  c("SHASH", "Sinh-Arcsinh"), Fitting method: "nlminb" with 12% error
# Call:  gamlssML(formula = y, family = DIST[i])
```

Visualizing fistDist:

```
histDist(y, family = SHASH, density = FALSE,
        nbins = 10, xlab = "x", ylab = "y", data = PAM_visual,
        col.hist = "gray", border.hist = "blue",
        fg.hist = rainbow(12)[9])
```




```
##
## Family:  c("SHASH", "Sinh-Arcsinh")
## Fitting method: "nlminb"
##
```

```
## Call:  gamlssML(formula = y, family = "SHASH", data = PAM_visual)
##
## Mu Coefficients:
## [1]  0.4756
## Sigma Coefficients:
## [1]  8.663
## Nu Coefficients:
## [1]  9.757
## Tau Coefficients:
## [1]  11.12
##
##  Degrees of Freedom for the fit: 4 Residual Deg. of Freedom   347
## Global Deviance:     -469.418
##             AIC:     -461.418
##             SBC:     -445.975
```

Modelling fitDist:

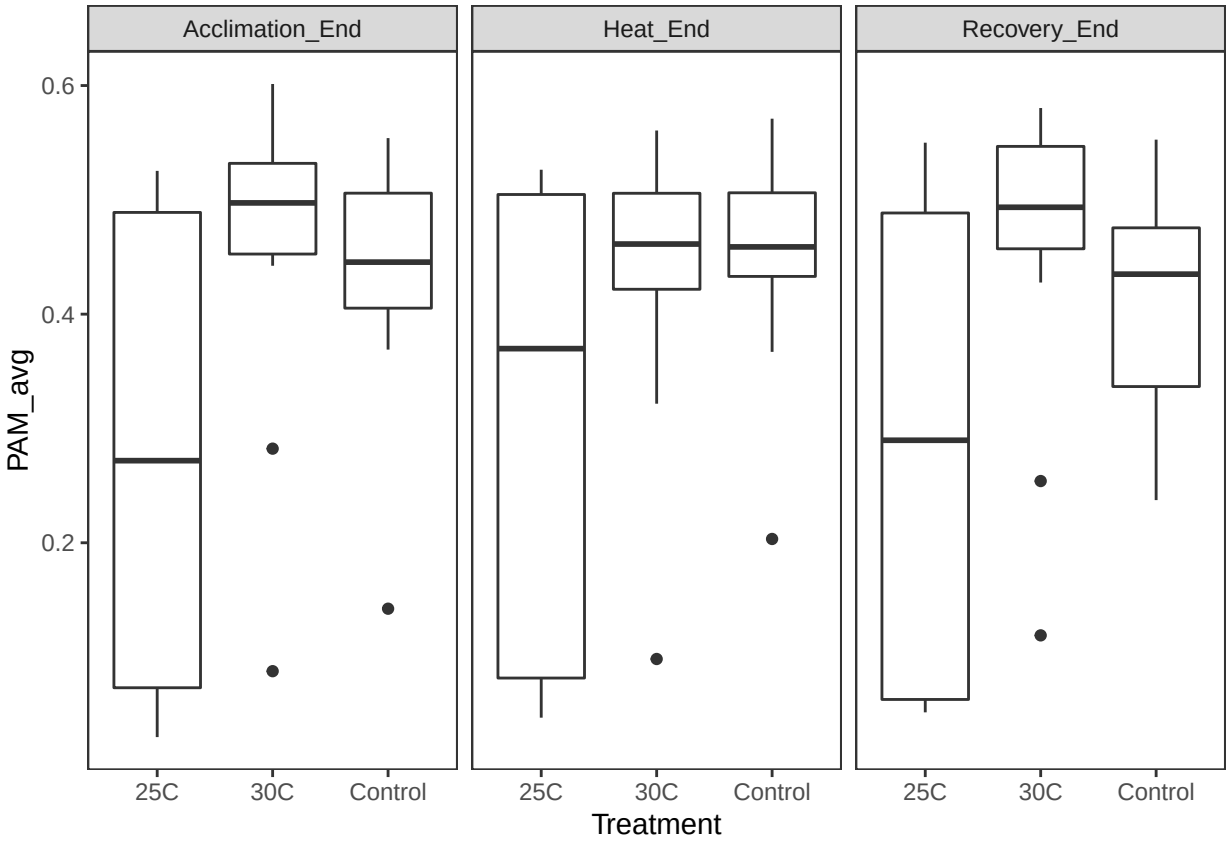
```
SHASH_data <- health_data %>%
  select(-c(Event, Field_Site, Acclimation_Period, Base_Width, Base_Length, Base_Diagonal, Base_Diameter
  drop_na(PAM_avg) %>%
  drop_na(Event_True) %>%
  drop_na(Time_Point)

gamlssML(formula = PAM_avg ~ Event_True*Time_Point + random(Species_ID), family = SHASH, data = SHASH_da
```

```
##
## Family:  c("SHASH", "Sinh-Arcsinh")
## Fitting method: "nlminb"
##
## Call:  gamlssML(formula = PAM_avg ~ Event_True * Time_Point +
##     random(Species_ID), family = SHASH, data = SHASH_data)
##
## Mu Coefficients:
## [1]  0.479
## Sigma Coefficients:
## [1]  8.761
## Nu Coefficients:
## [1]  9.843
## Tau Coefficients:
## [1]  11.24
##
##  Degrees of Freedom for the fit: 4 Residual Deg. of Freedom   321
## Global Deviance:     -438.049
##             AIC:     -430.049
##             SBC:     -414.913
```

PAM Graph We see no significant differences between treatments at different times of the experiment.

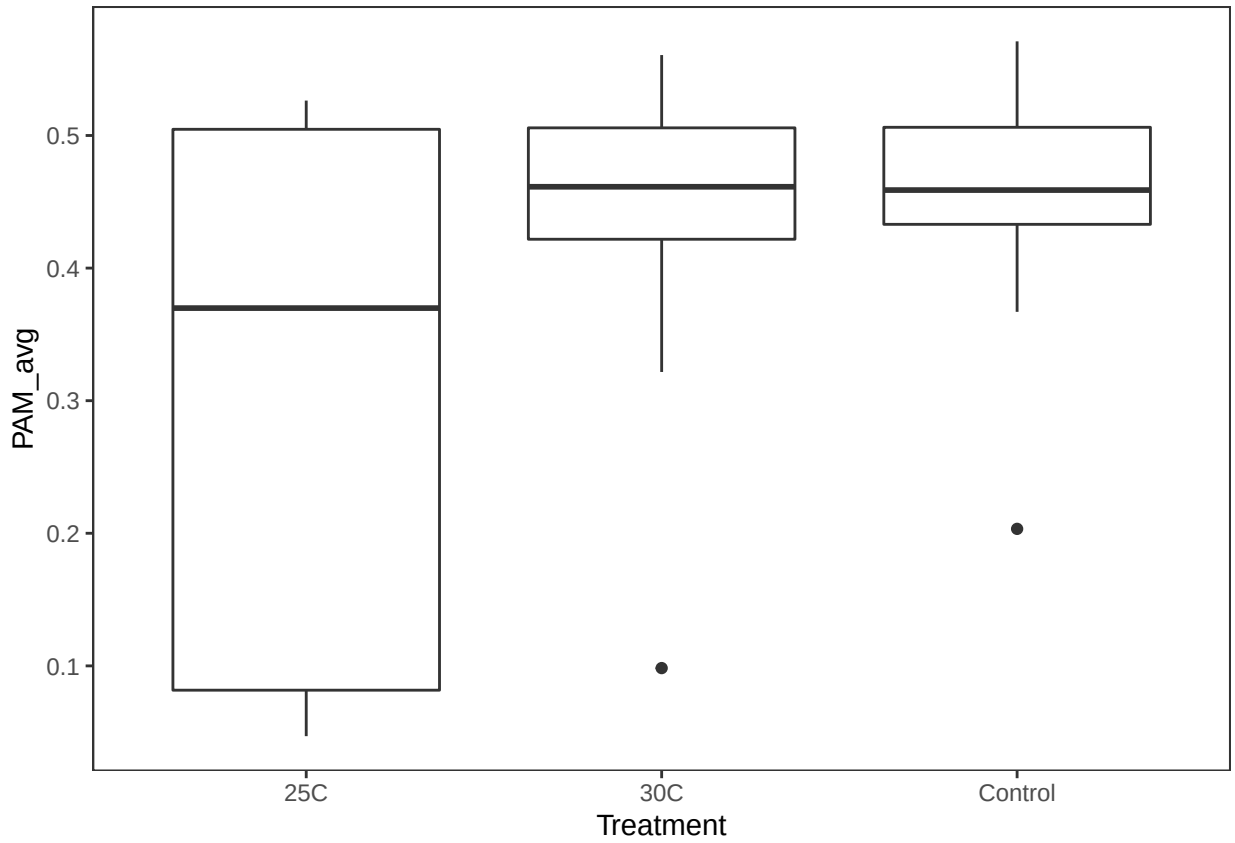
```
PAM_data_plot <- health_data %>%
  filter(Event_True == "Acclimation_End" | Event_True == "Heat_End" | Event_True == "Recovery_End")

ggplot(PAM_data_plot, aes(x = Treatment, y = PAM_avg)) +
```

```
  geom_boxplot() +
  facet_grid(. ~ Event_True) +
  theme_test()
```




```
PAM_data_end <- health_data %>%
  filter(Event_True == "Heat_End") %>%
  drop_na(PAM_avg)
```

```
ggplot(PAM_data_end, aes(x = Treatment, y = PAM_avg)) +
  geom_boxplot() +
  theme_test()
```



Symbiont Data

```
filtered_dates <- health_data %>%
  filter(Date == "11/5/2021" | Date == "11/9/2021" | Date == "11/13/2021")

shapiro.test(filtered_dates$Green_Density)      #p-value < 0.05, not normal distribution
```

```
##
##  Shapiro-Wilk normality test
##
## data:  filtered_dates$Green_Density
## W = 0.7423, p-value = 5.216e-06
```

```
bartlett.test(Green_Density ~ Treatment, filtered_dates)      #p-value < 0.05, does not meet assumption
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  Green_Density by Treatment
## Bartlett's K-squared = 10.599, df = 2, p-value = 0.004994
```

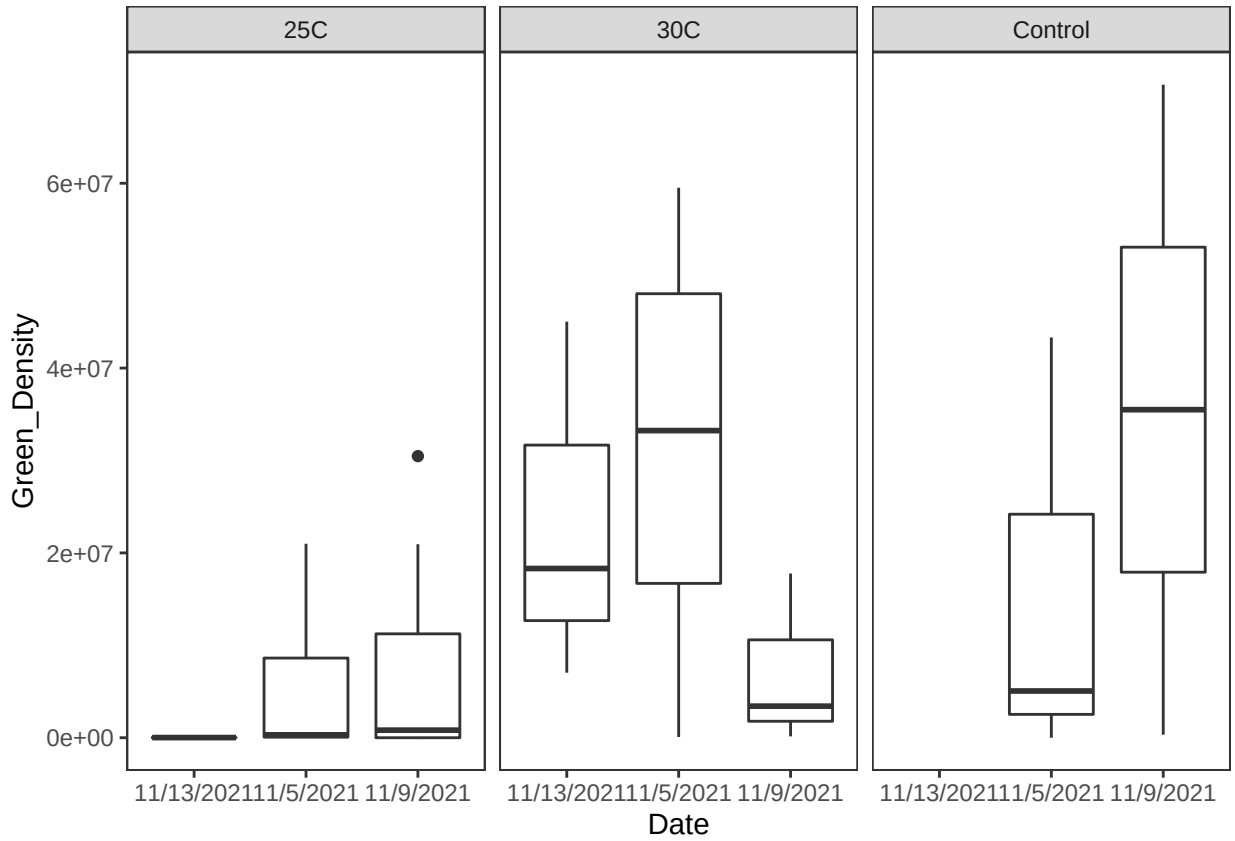
```r
shapiro.test(filtered_dates$Dino_Density)      #p-value < 0.05, not normal distribution
```

```
##
##  Shapiro-Wilk normality test
##
## data:  filtered_dates$Dino_Density
## W = 0.46439, p-value = 1.572e-09
```

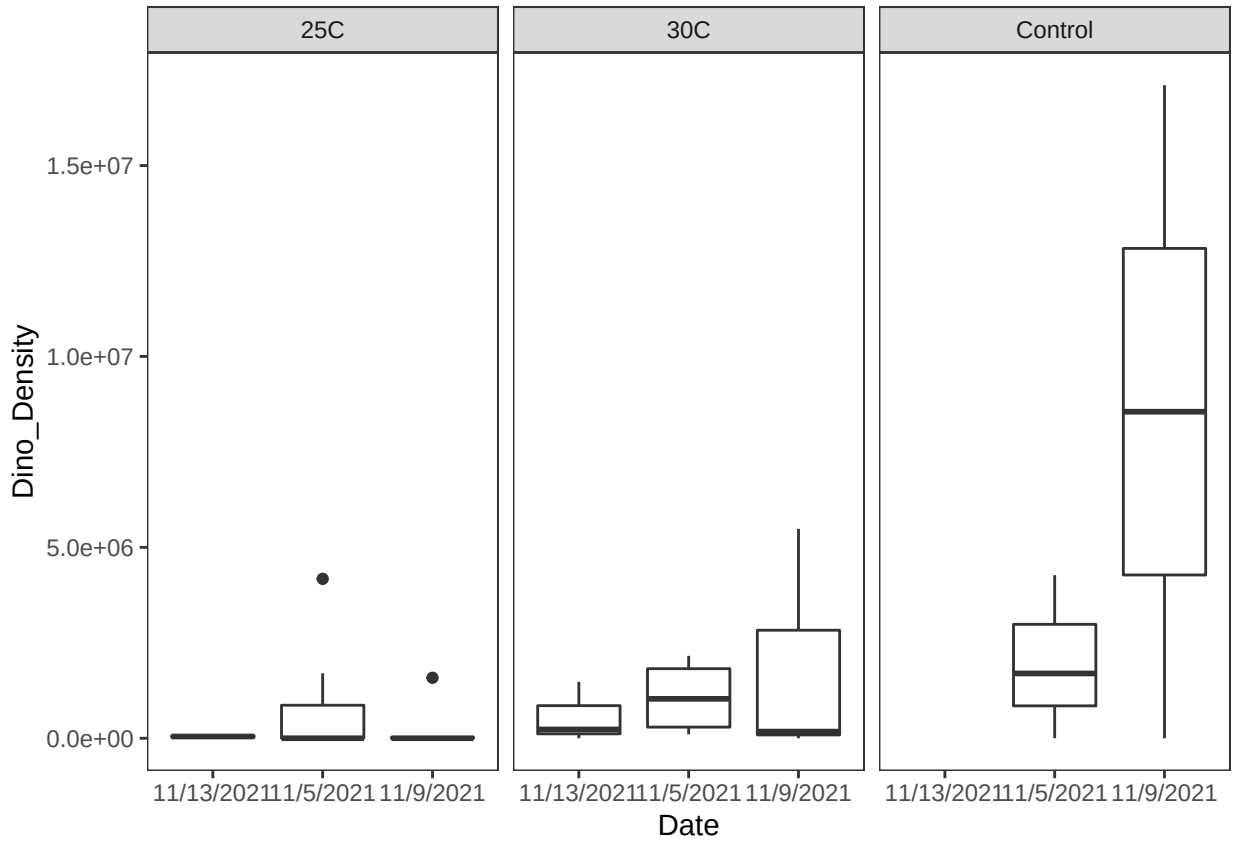
```r
bartlett.test(Dino_Density ~ Treatment, filtered_dates)      #p-value < 0.05, does not meet assumption
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  Dino_Density by Treatment
## Bartlett's K-squared = 30.44, df = 2, p-value = 2.455e-07
```

```r
ggplot(filtered_dates, aes(x = Date, y = Green_Density)) +
  geom_boxplot() +
  facet_grid(. ~ Treatment) +
  theme_test()
```




```r
ggplot(filtered_dates, aes(x = Date, y = Dino_Density)) +
  geom_boxplot() +
  facet_grid(. ~ Treatment) +
  theme_test()
```



Size Data

```
shapiro.test(filtered_dates$Base_Diameter_mm) # p-value = 0.001, distribution is not normal
```

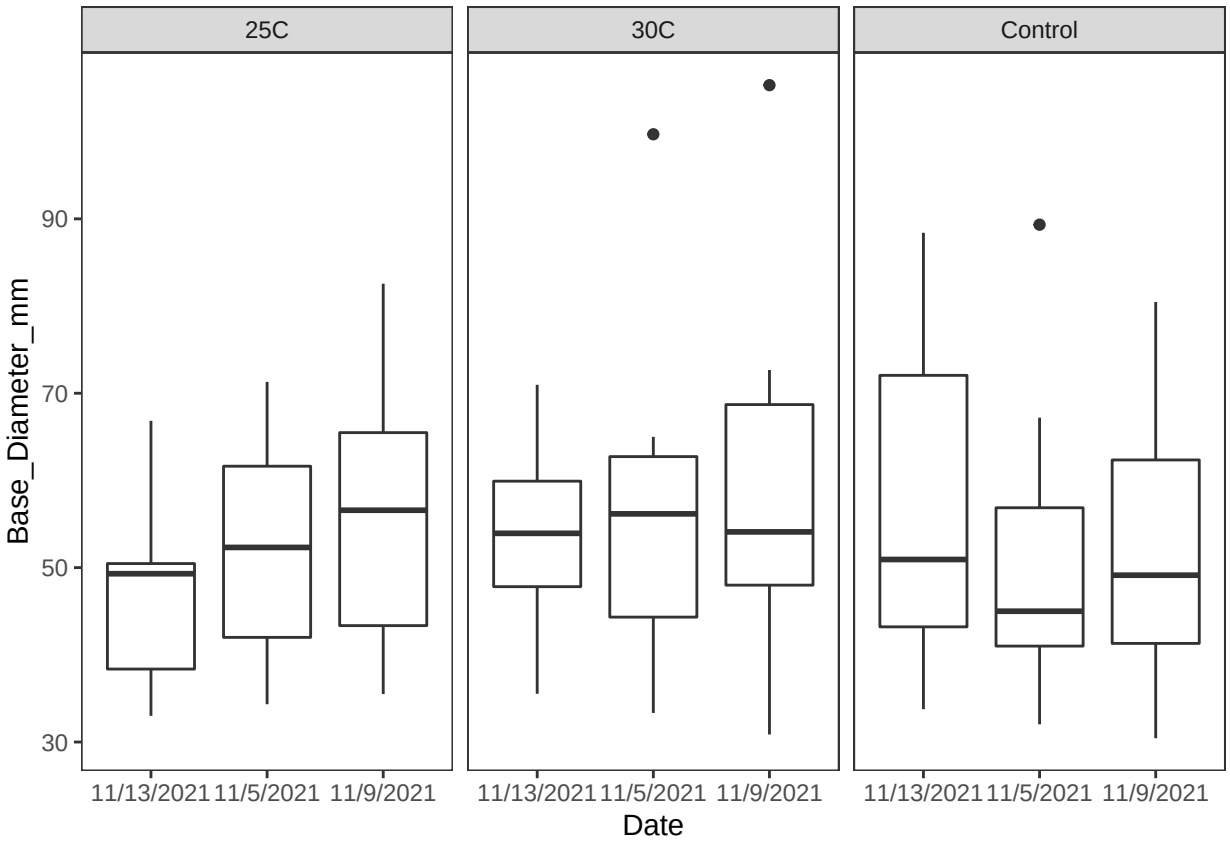
```
##
##  Shapiro-Wilk normality test
##
## data:  filtered_dates$Base_Diameter_mm
## W = 0.95422, p-value = 0.001308
```

```
bartlett.test(Base_Diameter_mm ~ Treatment, data = filtered_dates) # p-value = 0.30, yay equal variance
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  Base_Diameter_mm by Treatment
## Bartlett's K-squared = 2.3794, df = 2, p-value = 0.3043
```

Size Graph

```
ggplot(filtered_dates, aes(x = Date, y = Base_Diameter_mm)) +
  geom_boxplot() +
  facet_grid(. ~ Treatment) +
  theme_test()
```



Feeding Data

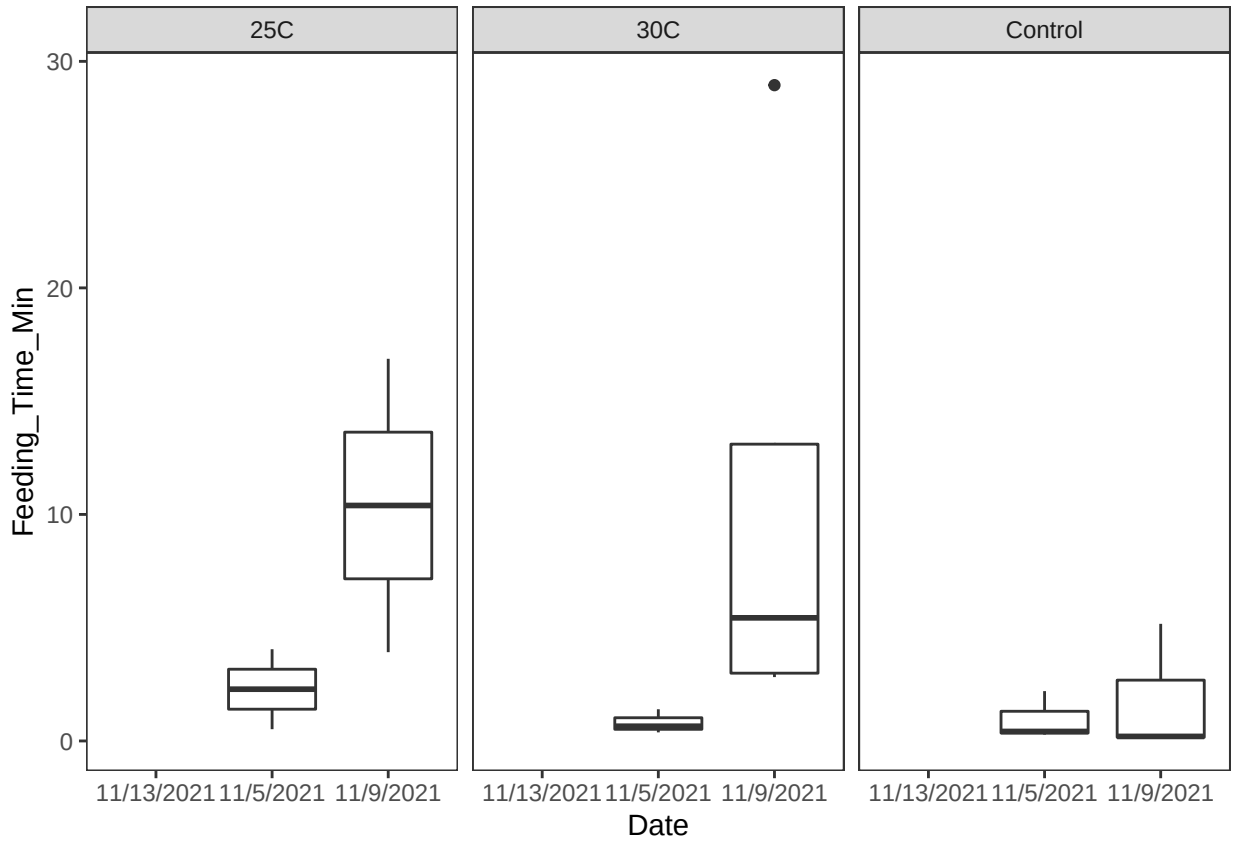
```
shapiro.test(filtered_dates$Feeding_Time_Min)      #p-value < 0.05, not normal distribution
```

```
##
##  Shapiro-Wilk normality test
##
## data:  filtered_dates$Feeding_Time_Min
## W = 0.62812, p-value = 1.973e-05
```

```
bartlett.test(Feeding_Time_Min ~ Treatment, filtered_dates)      #p-value < 0.01, does not meet assumpt
```

```
##
##  Bartlett test of homogeneity of variances
##
## data:  Feeding_Time_Min by Treatment
## Bartlett's K-squared = 9.0434, df = 2, p-value = 0.01087
```

```
ggplot(filtered_dates, aes(x = Date, y = Feeding_Time_Min)) +
  geom_boxplot() +
  facet_grid(. ~ Treatment) +
  theme_test()
```

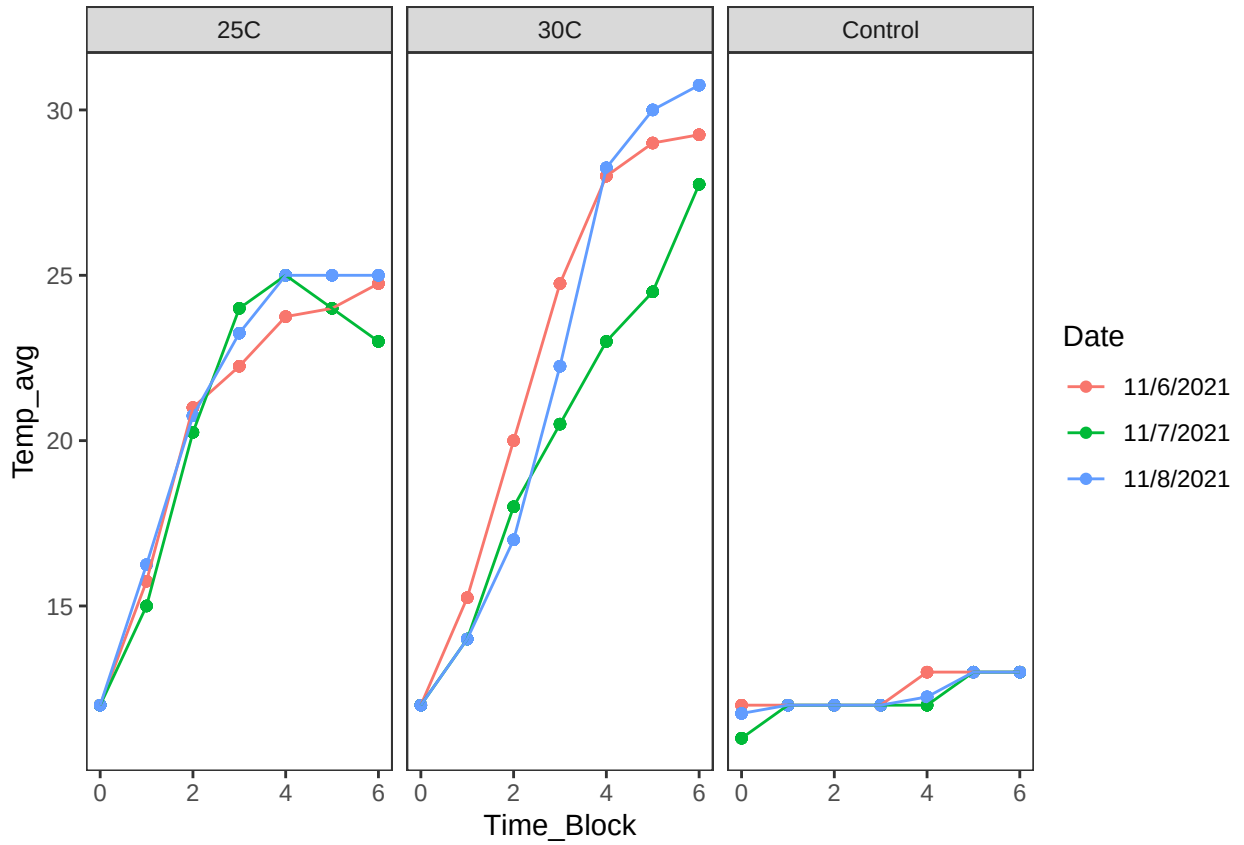


Heat Data

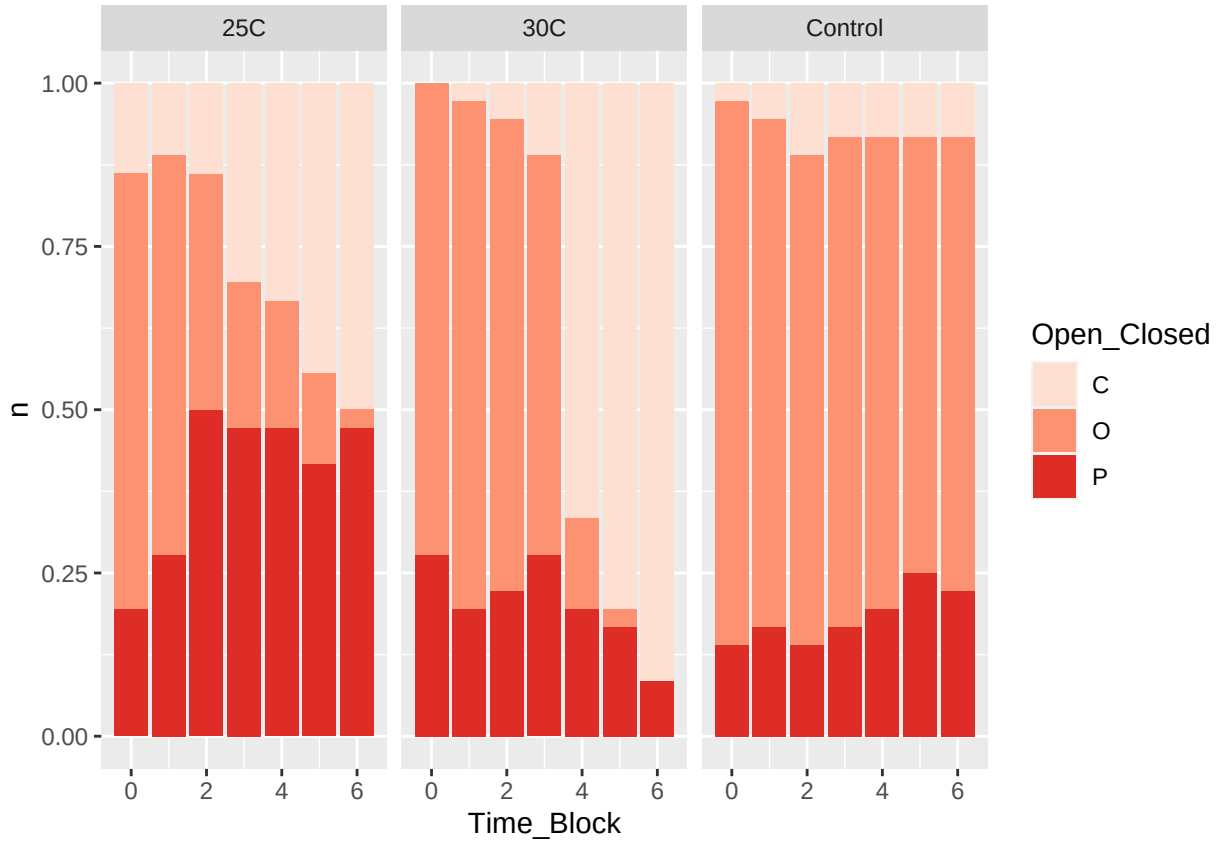
Includes temperature during heatwave and behabiroual responses (open vs closed)

```
heat_data <- heat_data %>%
  mutate(Bucket = as.factor(Bucket), Treatment = as.factor(Treatment), Field_Site = as.factor(Field_Sit
  group_by(Date, Treatment, Time_Block) %>%
  mutate(Temp_avg = mean(Bucket_Temp))
```

```
ggplot(data = heat_data, aes(x = Time_Block, y = Temp_avg, color = Date)) +
  geom_point() +
  geom_line() +
  facet_grid(. ~ Treatment) +
  theme_test()
```




```
open_closed_data <- heat_data %>%
  group_by(Day, Treatment, Time_Block) %>%
  count(Open_Closed)

ggplot(data = open_closed_data, aes(x = Time_Block, y = n, fill = Open_Closed)) +
  geom_bar(position="fill", stat="identity") +
  facet_grid(. ~ Treatment) +
  scale_fill_brewer(palette = "Reds")
```




```
  theme_classic()
```

```
## List of 93
##  $ line                        :List of 6
##   ..$ colour       : chr "black"
##   ..$ size         : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ rect                        :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ size         : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ text                        :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
```

```
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ title                     : NULL
##  $ aspect.ratio              : NULL
##  $ axis.title                : NULL
##  $ axis.title.x              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.75points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.top          :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.75points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.bottom       : NULL
##  $ axis.title.y              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.75points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.y.left         : NULL
```

```
##  $ axis.title.y.right        :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.75points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text                 :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey30"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.2points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.top           :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.2points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
```

```
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.bottom        : NULL
##  $ axis.text.y               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 1
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.y.left          : NULL
##  $ axis.text.y.right         :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.ticks                :List of 6
##   ..$ colour       : chr "grey20"
##   ..$ size         : NULL
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ axis.ticks.x              : NULL
##  $ axis.ticks.x.top          : NULL
##  $ axis.ticks.x.bottom       : NULL
##  $ axis.ticks.y              : NULL
##  $ axis.ticks.y.left         : NULL
##  $ axis.ticks.y.right        : NULL
##  $ axis.ticks.length         : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ axis.ticks.length.x       : NULL
##  $ axis.ticks.length.x.top   : NULL
##  $ axis.ticks.length.x.bottom: NULL
##  $ axis.ticks.length.y       : NULL
##  $ axis.ticks.length.y.left  : NULL
##  $ axis.ticks.length.y.right : NULL
##  $ axis.line                 :List of 6
```

```
##   ..$ colour       : chr "black"
##   ..$ size         : 'rel' num 1
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ axis.line.x               : NULL
##  $ axis.line.x.top           : NULL
##  $ axis.line.x.bottom        : NULL
##  $ axis.line.y               : NULL
##  $ axis.line.y.left          : NULL
##  $ axis.line.y.right         : NULL
##  $ legend.background         :List of 5
##   ..$ fill         : NULL
##   ..$ colour       : logi NA
##   ..$ size         : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ legend.margin             : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing            : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing.x          : NULL
##  $ legend.spacing.y          : NULL
##  $ legend.key                : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.key.size           : 'simpleUnit' num 1.2lines
##   ..- attr(*, "unit")= int 3
##  $ legend.key.height         : NULL
##  $ legend.key.width          : NULL
##  $ legend.text               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.text.align         : NULL
##  $ legend.title              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
```

```
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.title.align        : NULL
##  $ legend.position           : chr "right"
##  $ legend.direction          : NULL
##  $ legend.justification      : chr "center"
##  $ legend.box                : NULL
##  $ legend.box.just           : NULL
##  $ legend.box.margin         : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
##  $ legend.box.background     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.box.spacing        : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ panel.background          :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : logi NA
##   ..$ size         : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ panel.border              : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.spacing             : 'simpleUnit' num 5.5points
##   ..- attr(*, "unit")= int 8
##  $ panel.spacing.x           : NULL
##  $ panel.spacing.y           : NULL
##  $ panel.grid                :List of 6
##   ..$ colour       : chr "grey92"
##   ..$ size         : NULL
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ panel.grid.major          : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.grid.minor          : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.grid.major.x        : NULL
##  $ panel.grid.major.y        : NULL
##  $ panel.grid.minor.x        : NULL
##  $ panel.grid.minor.y        : NULL
##  $ panel.ontop               : logi FALSE
##  $ plot.background           :List of 5
##   ..$ fill         : NULL
##   ..$ colour       : chr "white"
##   ..$ size         : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
```

```
##  $ plot.title               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 1.2
##   ..$ hjust        : num 0
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 5.5points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.title.position       : chr "panel"
##  $ plot.subtitle             :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 5.5points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.caption              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : num 1
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 5.5points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.caption.position     : chr "panel"
##  $ plot.tag                  :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 1.2
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
```

```
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.tag.position         : chr "topleft"
##  $ plot.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ strip.background          :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ size         : 'rel' num 2
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ strip.background.x        : NULL
##  $ strip.background.y        : NULL
##  $ strip.placement           : chr "inside"
##  $ strip.text                :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey10"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 4.4points 4.4points 4.4points 4.4points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ strip.text.x              : NULL
##  $ strip.text.y              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ strip.switch.pad.grid     : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ strip.switch.pad.wrap     : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ strip.text.y.left         :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
```

```
##   ..$ vjust        : NULL
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  - attr(*, "class")= chr [1:2] "theme" "gg"
##  - attr(*, "complete")= logi TRUE
##  - attr(*, "validate")= logi TRUE
```