Data\_Rodolphe

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2024-05-06

## R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

Rod\_eg <- read.csv("/Users/fabriceg/Rodolphe/Egg\_rod.csv", header = TRUE, sep = ",")  
names(Rod\_eg)

## [1] "date" "season" "collect\_number" "plot"   
## [5] "FAW\_egg" "rh2m\_." "precipitation" "t2m\_Max"   
## [9] "t2m\_Min" "t2m\_avairage"

names <- c('date','season', 'collect\_number', 'plot', 'FAW\_egg','rh2m\_%', 'precipitation', 't2m\_Max', 't2m\_Min','t2m\_avairage')  
  
Rod\_eg$date = as.factor(Rod\_eg$date)  
Rod\_eg$season = as.factor(Rod\_eg$season)  
Rod\_eg$collect\_number = as.factor(Rod\_eg$collect\_number)  
Rod\_eg$plot = as.factor(Rod\_eg$plot)  
  
str(Rod\_eg)

## 'data.frame': 240 obs. of 10 variables:  
## $ date : Factor w/ 12 levels " 02/11/2020",..: 11 11 11 11 11 11 11 11 11 11 ...  
## $ season : Factor w/ 2 levels "1","2": 1 1 1 1 1 1 1 1 1 1 ...  
## $ collect\_number: Factor w/ 6 levels "1","2","3","4",..: 1 1 1 1 1 1 1 1 1 1 ...  
## $ plot : Factor w/ 4 levels "1","2","3","4": 1 1 1 1 1 2 2 2 2 2 ...  
## $ FAW\_egg : int 0 0 1 0 0 0 0 0 0 0 ...  
## $ rh2m\_. : num 82.2 82.2 82.2 82.2 82.2 ...  
## $ precipitation : num 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 ...  
## $ t2m\_Max : num 32.3 32.3 32.3 32.3 32.3 ...  
## $ t2m\_Min : num 23.6 23.6 23.6 23.6 23.6 ...  
## $ t2m\_avairage : num 28 28 28 28 28 ...

#Percentage of controled variability  
anovaVCA(FAW\_egg ~ season + season:collect\_number, Data=Rod\_eg);

##   
##   
## Result Variance Component Analysis:  
## -----------------------------------  
##   
## Name DF SS MS VC %Total   
## 1 total 38.429903 0.626875 100   
## 2 season 1 11.266667 11.266667 0.080292 12.808242  
## 3 season:collect\_number 10 16.316667 1.631667 0.05711 9.110213   
## 4 error 228 111.6 0.489474 0.489474 78.081545  
## SD CV[%]   
## 1 0.791754 202.150055  
## 2 0.283358 72.346683   
## 3 0.238976 61.015213   
## 4 0.699624 178.627394  
##   
## Mean: 0.391667 (N = 240)   
##   
## Experimental Design: balanced | Method: ANOVA

aov\_result <- aov(FAW\_egg ~ season + collect\_number + plot + season:collect\_number + season:plot + collect\_number:plot + season\*collect\_number\*plot, data = Rod\_eg)  
summary(aov\_result)

## Df Sum Sq Mean Sq F value Pr(>F)   
## season 1 11.27 11.267 23.616 2.44e-06 \*\*\*  
## collect\_number 5 6.88 1.377 2.886 0.01549 \*   
## plot 3 4.18 1.394 2.923 0.03517 \*   
## season:collect\_number 5 9.43 1.887 3.955 0.00195 \*\*   
## season:plot 3 4.40 1.467 3.074 0.02888 \*   
## collect\_number:plot 15 6.32 0.421 0.883 0.58442   
## season:collect\_number:plot 15 5.10 0.340 0.713 0.77003   
## Residuals 192 91.60 0.477   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

aov\_result21 <- lm(FAW\_egg ~ season + collect\_number + season:collect\_number, data = Rod\_eg)  
summary(aov\_result21)

##   
## Call:  
## lm(formula = FAW\_egg ~ season + collect\_number + season:collect\_number,   
## data = Rod\_eg)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.35 -0.35 -0.15 -0.10 3.45   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.500e-01 1.564e-01 1.598 0.111417   
## season2 -1.500e-01 2.212e-01 -0.678 0.498462   
## collect\_number2 1.100e+00 2.212e-01 4.972 1.3e-06 \*\*\*  
## collect\_number3 2.500e-01 2.212e-01 1.130 0.259667   
## collect\_number4 4.000e-01 2.212e-01 1.808 0.071926 .   
## collect\_number5 1.000e-01 2.212e-01 0.452 0.651701   
## collect\_number6 3.000e-01 2.212e-01 1.356 0.176444   
## season2:collect\_number2 -1.100e+00 3.129e-01 -3.516 0.000529 \*\*\*  
## season2:collect\_number3 1.040e-15 3.129e-01 0.000 1.000000   
## season2:collect\_number4 -3.500e-01 3.129e-01 -1.119 0.264473   
## season2:collect\_number5 5.000e-02 3.129e-01 0.160 0.873176   
## season2:collect\_number6 -3.000e-01 3.129e-01 -0.959 0.338660   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6996 on 228 degrees of freedom  
## Multiple R-squared: 0.1982, Adjusted R-squared: 0.1595   
## F-statistic: 5.123 on 11 and 228 DF, p-value: 3.605e-07

# Set contrast coding  
contrasts(Rod\_eg$season) <- contr.treatment(levels(Rod\_eg$season))  
contrasts(Rod\_eg$collect\_number) <- contr.treatment(levels(Rod\_eg$collect\_number))  
  
# Convert collect\_number to numeric  
Rod\_eg$collect\_number <- as.numeric(as.character(Rod\_eg$collect\_number))  
  
# Compute correlation between collect\_number and larvae  
correlation\_collect\_number\_egg <- cor.test(Rod\_eg$collect\_number, Rod\_eg$FAW\_egg)  
  
# Print correlation coefficient  
print("Correlation coefficient for collect\_number and FAW\_egg:")

## [1] "Correlation coefficient for collect\_number and FAW\_egg:"

print(correlation\_collect\_number\_egg$estimate)

## cor   
## -0.03524115

# Print p-value  
print("P-value for collect\_number and FAW\_egg:")

## [1] "P-value for collect\_number and FAW\_egg:"

print(correlation\_collect\_number\_egg$p.value)

## [1] 0.5869426

# Compute R-squared  
r\_squared\_collect\_number\_egg <- correlation\_collect\_number\_egg$estimate^2  
  
# Print R-squared  
print("R-squared for collect\_number and larvae:")

## [1] "R-squared for collect\_number and larvae:"

print(r\_squared\_collect\_number\_egg)

## cor   
## 0.001241939

# Compute correlation between precipitation and larvae  
correlation\_precipitation\_egg <- cor.test(Rod\_eg$precipitation, Rod\_eg$FAW\_egg)  
  
# Print correlation coefficient  
print("Correlation coefficient for precipitation and larvae:")

## [1] "Correlation coefficient for precipitation and larvae:"

print(correlation\_precipitation\_egg$estimate)

## cor   
## -0.01737229

# Print p-value  
print("P-value for precipitation and larvae:")

## [1] "P-value for precipitation and larvae:"

print(correlation\_precipitation\_egg$p.value)

## [1] 0.7888952

# Compute R-squared  
r\_squared\_precipitation\_egg <- correlation\_precipitation\_egg$estimate^2  
  
# Print R-squared  
print("R-squared for precipitation and FAW\_egg:")

## [1] "R-squared for precipitation and FAW\_egg:"

print(r\_squared\_precipitation\_egg)

## cor   
## 0.0003017964

# Compute correlation between temperature and FAW\_egg  
correlation\_temperature\_egg <- cor.test(Rod\_eg$t2m\_avairage, Rod\_eg$FAW\_egg)  
  
# Print correlation coefficient  
print("Correlation coefficient for temperature and FAW\_egg:")

## [1] "Correlation coefficient for temperature and FAW\_egg:"

print(correlation\_temperature\_egg$estimate)

## cor   
## 0.1488017

# Print p-value  
print("P-value for temperature and FAW\_egg:")

## [1] "P-value for temperature and FAW\_egg:"

print(correlation\_temperature\_egg$p.value)

## [1] 0.02110819

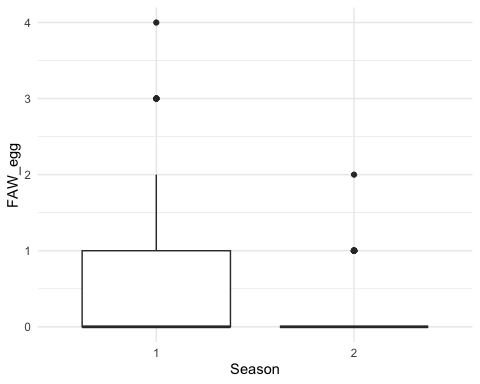
# Compute R-squared  
r\_squared\_temperature\_egg <- correlation\_temperature\_egg$estimate^2  
  
# Print R-squared  
print("R-squared for temperature and FAW\_egg:")

## [1] "R-squared for temperature and FAW\_egg:"

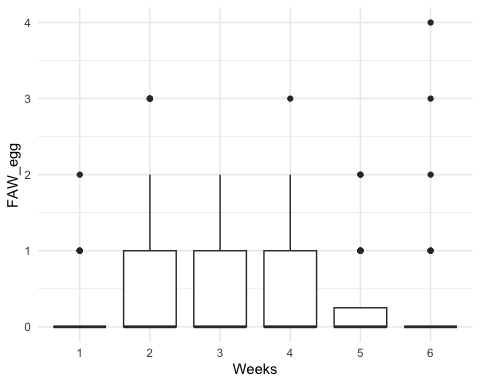
print(r\_squared\_temperature\_egg)

## cor   
## 0.02214195

# Box plot for season and FAW\_egg  
boxplot\_season\_egg <- ggplot(Rod\_eg, aes(x = season, y = FAW\_egg)) +  
 geom\_boxplot() +  
 labs(x = "Season", y = "FAW\_egg") +  
 theme\_minimal() # Optional: Apply a minimal theme  
  
# Print the box plot for season and larvae  
print(boxplot\_season\_egg)



Rod\_eg$collect\_number <- as.factor(Rod\_eg$collect\_number)  
  
# Box plot for collect\_number and larvae  
boxplot\_collect\_number\_egg <- ggplot(Rod\_eg, aes(x = collect\_number, y = FAW\_egg)) +  
 geom\_boxplot() +  
 labs(x = "Weeks", y = "FAW\_egg") +  
 theme\_minimal() # Optional: Apply a minimal theme  
  
# Print the box plot for collect\_number and larvae  
print(boxplot\_collect\_number\_egg)



## Including Plots

You can also embed plots, for example:

# Read the data  
Rod\_la <- read.csv("/Users/fabriceg/Rodolphe/Larva\_rod.csv", header = TRUE, sep = ",")  
  
# Rename columns  
names(Rod\_la) <- c('date', 'season', 'collect\_number', 'plot', 'larvae', 'rh2m\_%', 'precipitation', 't2m\_Max', 't2m\_Min', 't2m\_avairage')  
  
# Convert columns to factors  
Rod\_la$date <- as.factor(Rod\_la$date)  
Rod\_la$season <- as.factor(Rod\_la$season)  
Rod\_la$collect\_number <- as.factor(Rod\_la$collect\_number)  
Rod\_la$plot <- as.factor(Rod\_la$plot)  
  
# Print the structure of the dataframe  
str(Rod\_la)

## 'data.frame': 120 obs. of 10 variables:  
## $ date : Factor w/ 6 levels " 02/11/2020",..: 6 6 6 6 6 6 6 6 6 6 ...  
## $ season : Factor w/ 2 levels "1","2": 1 1 1 1 1 1 1 1 1 1 ...  
## $ collect\_number: Factor w/ 3 levels "1","3","5": 1 1 1 1 1 1 1 1 1 1 ...  
## $ plot : Factor w/ 4 levels "1","2","3","4": 1 1 1 1 1 2 2 2 2 2 ...  
## $ larvae : int 0 0 0 0 0 0 0 0 0 1 ...  
## $ rh2m\_% : num 82.2 82.2 82.2 82.2 82.2 ...  
## $ precipitation : num 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 ...  
## $ t2m\_Max : num 32.3 32.3 32.3 32.3 32.3 ...  
## $ t2m\_Min : num 23.6 23.6 23.6 23.6 23.6 ...  
## $ t2m\_avairage : num 28 28 28 28 28 ...

#Percentage of controlled variability  
print(anovaVCA(larvae ~ season + season:collect\_number, Data = Rod\_la))

##   
##   
## Result Variance Component Analysis:  
## -----------------------------------  
##   
## Name DF SS MS VC %Total   
## 1 total 5.499626 72.873611 100   
## 2 season 1 1748.033333 1748.033333 18.532778 25.431398  
## 3 season:collect\_number 4 2544.266667 636.066667 30.617149 42.014041  
## 4 error 114 2704.5 23.723684 23.723684 32.554561  
## SD CV[%]   
## 1 8.536604 158.085263  
## 2 4.304971 79.72169   
## 3 5.533277 102.468084  
## 4 4.870696 90.198083   
##   
## Mean: 5.4 (N = 120)   
##   
## Experimental Design: balanced | Method: ANOVA

# Perform linear regression  
aov\_result11 <- lm(larvae ~ season + collect\_number + season:collect\_number, data = Rod\_la)  
summary(aov\_result11)

##   
## Call:  
## lm(formula = larvae ~ season + collect\_number + season:collect\_number,   
## data = Rod\_la)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -14.7000 -1.1000 -0.5000 0.6375 22.5000   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 0.450 1.089 0.413 0.680253   
## season2 0.200 1.540 0.130 0.896915   
## collect\_number3 15.250 1.540 9.901 < 2e-16 \*\*\*  
## collect\_number5 11.050 1.540 7.174 7.85e-11 \*\*\*  
## season2:collect\_number3 -14.800 2.178 -6.794 5.21e-10 \*\*\*  
## season2:collect\_number5 -8.700 2.178 -3.994 0.000115 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 4.871 on 114 degrees of freedom  
## Multiple R-squared: 0.6135, Adjusted R-squared: 0.5965   
## F-statistic: 36.19 on 5 and 114 DF, p-value: < 2.2e-16

# Perform anova  
aov\_result1 <- aov(larvae ~ season + collect\_number + season:collect\_number, data = Rod\_la)  
summary(aov\_result1)

## Df Sum Sq Mean Sq F value Pr(>F)   
## season 1 1748 1748.0 73.68 5.35e-14 \*\*\*  
## collect\_number 2 1438 718.9 30.30 2.79e-11 \*\*\*  
## season:collect\_number 2 1106 553.2 23.32 3.24e-09 \*\*\*  
## Residuals 114 2704 23.7   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

# Set contrast coding  
contrasts(Rod\_la$season) <- contr.treatment(levels(Rod\_la$season))  
contrasts(Rod\_la$collect\_number) <- contr.treatment(levels(Rod\_la$collect\_number))  
  
# Convert collect\_number to numeric  
Rod\_la$collect\_number <- as.numeric(as.character(Rod\_la$collect\_number))  
  
# Compute correlation between collect\_number and larvae  
correlation\_collect\_number\_larvae <- cor.test(Rod\_la$collect\_number, Rod\_la$larvae)  
  
# Print correlation coefficient  
print("Correlation coefficient for collect\_number and larvae:")

## [1] "Correlation coefficient for collect\_number and larvae:"

print(correlation\_collect\_number\_larvae$estimate)

## cor   
## 0.358212

# Print p-value  
print("P-value for collect\_number and larvae:")

## [1] "P-value for collect\_number and larvae:"

print(correlation\_collect\_number\_larvae$p.value)

## [1] 5.89222e-05

# Compute R-squared  
r\_squared\_collect\_number\_larvae <- correlation\_collect\_number\_larvae$estimate^2  
  
# Print R-squared  
print("R-squared for collect\_number and larvae:")

## [1] "R-squared for collect\_number and larvae:"

print(r\_squared\_collect\_number\_larvae)

## cor   
## 0.1283158

# Compute correlation between precipitation and larvae  
correlation\_precipitation\_larvae <- cor.test(Rod\_la$precipitation, Rod\_la$larvae)  
  
# Print correlation coefficient  
print("Correlation coefficient for precipitation and larvae:")

## [1] "Correlation coefficient for precipitation and larvae:"

print(correlation\_precipitation\_larvae$estimate)

## cor   
## 0.3700481

# Print p-value  
print("P-value for precipitation and larvae:")

## [1] "P-value for precipitation and larvae:"

print(correlation\_precipitation\_larvae$p.value)

## [1] 3.183799e-05

# Compute R-squared  
r\_squared\_precipitation\_larvae <- correlation\_precipitation\_larvae$estimate^2  
  
# Print R-squared  
print("R-squared for precipitation and larvae:")

## [1] "R-squared for precipitation and larvae:"

print(r\_squared\_precipitation\_larvae)

## cor   
## 0.1369356

# Compute correlation between temperature and larvae  
correlation\_temperature\_larvae <- cor.test(Rod\_la$t2m\_avairage, Rod\_la$larvae)  
  
# Print correlation coefficient  
print("Correlation coefficient for temperature and larvae:")

## [1] "Correlation coefficient for temperature and larvae:"

print(correlation\_temperature\_larvae$estimate)

## cor   
## -0.1201365

# Print p-value  
print("P-value for temperature and larvae:")

## [1] "P-value for temperature and larvae:"

print(correlation\_temperature\_larvae$p.value)

## [1] 0.191215

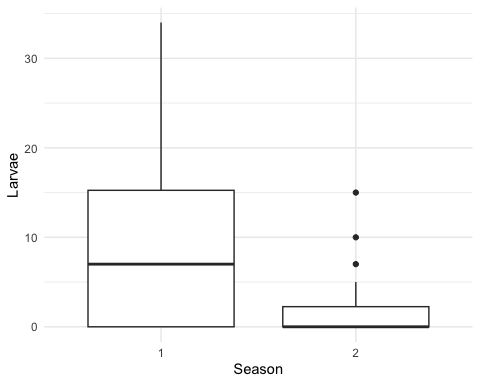
# Compute R-squared  
r\_squared\_temperature\_larvae <- correlation\_temperature\_larvae$estimate^2  
  
# Print R-squared  
print("R-squared for temperature and larvae:")

## [1] "R-squared for temperature and larvae:"

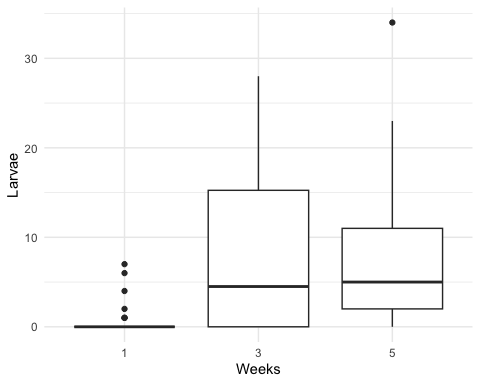
print(r\_squared\_temperature\_larvae)

## cor   
## 0.01443277

# Box plot for season and larvae  
boxplot\_season\_larvae <- ggplot(Rod\_la, aes(x = season, y = larvae)) +  
 geom\_boxplot() +  
 labs(x = "Season", y = "Larvae") +  
 theme\_minimal() # Optional: Apply a minimal theme  
  
# Print the box plot for season and larvae  
print(boxplot\_season\_larvae)



Rod\_la$collect\_number <- as.factor(Rod\_la$collect\_number)  
  
# Box plot for collect\_number and larvae  
boxplot\_collect\_number\_larvae <- ggplot(Rod\_la, aes(x = collect\_number, y = larvae)) +  
 geom\_boxplot() +  
 labs(x = "Weeks", y = "Larvae") +  
 theme\_minimal() # Optional: Apply a minimal theme  
  
# Print the box plot for collect\_number and larvae  
print(boxplot\_collect\_number\_larvae)



Rod\_da <- read.csv("/Users/fabriceg/Rodolphe/Damage\_rod.csv", header = TRUE, sep = ",")  
names(Rod\_da)

## [1] "date" "season" "collect\_number"   
## [4] "plot" "plant\_damaged" "damage\_level"   
## [7] "rh2m\_." "precipitation..mm.day." "t2m\_Max"   
## [10] "t2m\_Min" "t2m\_avairage"

names <- c('date','season', 'collect\_number', 'plot','plant\_damage','damage\_level', 'rh2m\_%', 'precipitation', 't2m\_Max', 't2m\_Min','t2m\_avairage')  
  
Rod\_da$date = as.factor(Rod\_da$date)  
Rod\_da$season = as.factor(Rod\_da$season)  
Rod\_da$collect\_number = as.factor(Rod\_da$collect\_number)  
Rod\_da$plot = as.factor(Rod\_da$plot)  
  
  
str(Rod\_da)

## 'data.frame': 600 obs. of 11 variables:  
## $ date : Factor w/ 2 levels "21/5/2020","8/5/20": 2 2 2 2 2 2 2 2 2 2 ...  
## $ season : Factor w/ 1 level "1": 1 1 1 1 1 1 1 1 1 1 ...  
## $ collect\_number : Factor w/ 2 levels "1","2": 1 1 1 1 1 1 1 1 1 1 ...  
## $ plot : Factor w/ 4 levels "1","2","3","4": 1 1 1 1 1 1 1 1 1 1 ...  
## $ plant\_damaged : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ damage\_level : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ rh2m\_. : num 82.2 82.2 82.2 82.2 82.2 ...  
## $ precipitation..mm.day.: num 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 8.77 ...  
## $ t2m\_Max : num 32.3 32.3 32.3 32.3 32.3 ...  
## $ t2m\_Min : num 23.6 23.6 23.6 23.6 23.6 ...  
## $ t2m\_avairage : num 28 28 28 28 28 ...

#Percentage of controled variability  
anovaVCA(damage\_level ~ collect\_number, Data=Rod\_da);

##   
##   
## Result Variance Component Analysis:  
## -----------------------------------  
##   
## Name DF SS MS VC %Total SD   
## 1 total 6.150957 6.496 100 2.548725  
## 2 collect\_number 1 784.326667 784.326667 2.60144 40.046804 1.612898  
## 3 error 598 2328.946667 3.89456 3.89456 59.953196 1.973464  
## CV[%]   
## 1 220.350879  
## 2 139.443642  
## 3 170.616473  
##   
## Mean: 1.156667 (N = 600)   
##   
## Experimental Design: balanced | Method: ANOVA

#Multinomial regression  
  
R1 <- multinom(damage\_level ~ collect\_number, data = Rod\_da)

## # weights: 27 (16 variable)  
## initial value 1318.334746   
## iter 10 value 542.286386  
## iter 20 value 528.557514  
## iter 30 value 528.509748  
## final value 528.509700   
## converged

summary(R1)

## Call:  
## multinom(formula = damage\_level ~ collect\_number, data = Rod\_da)  
##   
## Coefficients:  
## (Intercept) collect\_number2  
## 1 -22.606770 20.375412  
## 2 -5.003945 2.944438  
## 3 -21.305722 19.297508  
## 4 -22.306885 20.193310  
## 5 -20.716999 18.804095  
## 6 -22.299450 19.780411  
## 7 -18.533345 16.930596  
## 8 -22.773058 20.408169  
##   
## Std. Errors:  
## (Intercept) collect\_number2  
## 1 0.1315403 0.1315403  
## 2 0.7094752 0.7501321  
## 3 0.1190708 0.1190708  
## 4 0.1247668 0.1247668  
## 5 0.1141993 0.1141993  
## 6 0.1500373 0.1500373  
## 7 612.8534786 612.8535112  
## 8 0.1397676 0.1397676  
##   
## Residual Deviance: 1057.019   
## AIC: 1089.019

wald\_statistics1 <- summary(R1)$coefficients/summary(R1)$standard.errors  
p\_values1 <- 2 \* (1 - pnorm(abs(wald\_statistics1)))  
  
print(data.frame("Pr(>|z|)" = p\_values1))

## Pr...z....Intercept. Pr...z...collect\_number2  
## 1 0.000000e+00 0.000000e+00  
## 2 1.750822e-12 8.664841e-05  
## 3 0.000000e+00 0.000000e+00  
## 4 0.000000e+00 0.000000e+00  
## 5 0.000000e+00 0.000000e+00  
## 6 0.000000e+00 0.000000e+00  
## 7 9.758748e-01 9.779606e-01  
## 8 0.000000e+00 0.000000e+00

R2 <- multinom(damage\_level ~ plot, data = Rod\_da)

## # weights: 45 (32 variable)  
## initial value 1318.334746   
## iter 10 value 546.679016  
## iter 20 value 535.983465  
## iter 30 value 535.321257  
## final value 535.319447   
## converged

summary(R2)

## Call:  
## multinom(formula = damage\_level ~ plot, data = Rod\_da)  
##   
## Coefficients:  
## (Intercept) plot2 plot3 plot4  
## 1 -1.767662 -1.8432565 -19.682920 -19.74111  
## 2 -2.008824 -0.5034815 -1.553641 -19.51902  
## 3 -2.209495 0.2080145 -2.739263 -19.03321  
## 4 -2.460804 0.3539614 -1.794817 -19.67458  
## 5 -2.104134 0.1026542 -2.151484 -18.13719  
## 6 -2.614957 0.1026502 -19.130172 -19.27818  
## 7 -2.327284 1.1142612 -16.055351 -16.15664  
## 8 -3.308108 1.4019381 -17.994449 -18.13703  
##   
## Std. Errors:  
## (Intercept) plot2 plot3 plot4  
## 1 0.2891776 0.7727467 1.355819e-06 1.351918e-06  
## 2 0.3210985 0.5322447 6.001636e-01 1.325155e-06  
## 3 0.3511499 0.4866413 1.063201e+00 1.791644e-06  
## 4 0.3937659 0.5288444 8.137249e-01 7.059324e-07  
## 5 0.3349553 0.4750879 7.869495e-01 5.511471e-06  
## 6 0.4229201 0.5992010 9.973763e-07 9.059535e-07  
## 7 0.3703996 0.4429040 8.262832e+02 8.427286e+02  
## 8 0.5878168 0.6707840 1.584971e-06 1.445881e-06  
##   
## Residual Deviance: 1070.639   
## AIC: 1134.639

wald\_statistics2 <- summary(R2)$coefficients/summary(R2)$standard.errors  
p\_values2 <- 2 \* (1 - pnorm(abs(wald\_statistics2)))  
  
print(data.frame("Pr(>|z|)" = p\_values2))

## Pr...z....Intercept. Pr...z...plot2 Pr...z...plot3 Pr...z...plot4  
## 1 9.794672e-10 0.01706377 0.000000000 0.000000  
## 2 3.947236e-10 0.34416964 0.009633999 0.000000  
## 3 3.130582e-10 0.66905205 0.009982627 0.000000  
## 4 4.120073e-10 0.50329710 0.027406359 0.000000  
## 5 3.346023e-10 0.82892992 0.006257882 0.000000  
## 6 6.285457e-10 0.86397859 0.000000000 0.000000  
## 7 3.317380e-10 0.01187600 0.984497432 0.984704  
## 8 1.825370e-08 0.03661787 0.000000000 0.000000

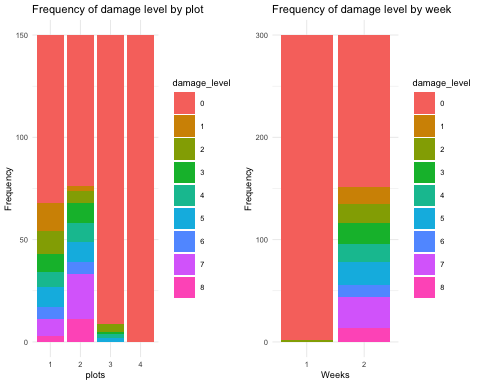
R3 <- multinom(damage\_level ~ collect\_number:plot, data = Rod\_da)

## # weights: 90 (72 variable)  
## initial value 1318.334746   
## iter 10 value 387.103962  
## iter 20 value 353.824689  
## iter 30 value 349.878613  
## iter 40 value 349.833889  
## final value 349.833844   
## converged

summary(R3)

## Call:  
## multinom(formula = damage\_level ~ collect\_number:plot, data = Rod\_da)  
##   
## Coefficients:  
## (Intercept) collect\_number1:plot1 collect\_number2:plot1 collect\_number1:plot2  
## 1 -13.230342 -9.061159 13.923489 -9.037839  
## 2 -6.564542 -14.272363 7.016526 2.260478  
## 3 -10.878194 -10.996084 11.129510 -10.978181  
## 4 -11.125082 -11.260770 11.125079 -11.243163  
## 5 -10.759049 -11.059959 11.115721 -11.043323  
## 6 -14.317774 -9.655380 14.163627 -9.624489  
## 7 -12.104560 -8.780573 12.238088 -8.768637  
## 8 -14.005376 -9.477263 13.158077 -9.450804  
## collect\_number2:plot2 collect\_number1:plot3 collect\_number2:plot3  
## 1 27.00611 -9.037839 -8.900786  
## 2 21.25660 2.260478 3.458461  
## 3 26.26341 -10.978181 6.673504  
## 4 26.40494 -11.243163 7.613538  
## 5 26.14426 -11.043323 7.247493  
## 6 29.19216 -9.624489 -9.458445  
## 7 28.27823 -8.768637 -8.741885  
## 8 29.48590 -9.450804 -9.315955  
## collect\_number1:plot4 collect\_number2:plot4  
## 1 -9.061159 -9.061159  
## 2 -14.272363 -14.272363  
## 3 -10.996084 -10.996084  
## 4 -11.260770 -11.260770  
## 5 -11.059959 -11.059959  
## 6 -9.655380 -9.655380  
## 7 -8.780573 -8.780573  
## 8 -9.477263 -9.477263  
##   
## Std. Errors:  
## (Intercept) collect\_number1:plot1 collect\_number2:plot1 collect\_number1:plot2  
## 1 0.2924647 2.227765e-09 0.3419599 2.278716e-09  
## 2 0.2916015 8.963460e-09 0.4704930 8.665528e-01  
## 3 0.3169556 4.290236e-09 0.4439358 4.342949e-09  
## 4 0.2629897 1.417040e-09 0.4253998 1.458655e-09  
## 5 0.2563965 2.473260e-09 0.3962872 2.543871e-09  
## 6 0.2624794 4.100251e-10 0.3582756 4.236211e-10  
## 7 0.2310502 8.875083e-09 0.3171309 9.002580e-09  
## 8 0.2882629 7.620324e-10 0.4378083 7.819166e-10  
## collect\_number2:plot2 collect\_number1:plot3 collect\_number2:plot3  
## 1 0.4366448 2.278716e-09 2.490675e-09  
## 2 0.4133625 8.665528e-01 5.596339e-01  
## 3 0.3313891 4.342949e-09 7.648486e-01  
## 4 0.3046424 1.458655e-09 5.608625e-01  
## 5 0.2936121 2.543871e-09 5.578037e-01  
## 6 0.2915319 4.236211e-10 4.806861e-10  
## 7 0.2001373 9.002580e-09 8.902550e-09  
## 8 0.2708373 7.819166e-10 8.523168e-10  
## collect\_number1:plot4 collect\_number2:plot4  
## 1 2.227764e-09 2.227764e-09  
## 2 8.963460e-09 8.963460e-09  
## 3 4.290237e-09 4.290237e-09  
## 4 1.417040e-09 1.417040e-09  
## 5 2.473260e-09 2.473260e-09  
## 6 4.100251e-10 4.100251e-10  
## 7 8.875083e-09 8.875083e-09  
## 8 7.620324e-10 7.620324e-10  
##   
## Residual Deviance: 699.6677   
## AIC: 827.6677

Rod\_da$damage\_level = as.factor(Rod\_da$damage\_level)  
# Set a common theme with reduced font size  
common\_theme <- theme\_minimal(base\_size = 7)  
  
# Create ggplots  
plot1 <- ggplot(Rod\_da, aes(x = plot, fill = damage\_level)) +  
 geom\_bar(position = "stack") +  
 labs(title = "Frequency of damage level by plot",  
 x = "plots", y = "Frequency") +  
 common\_theme  
  
plot2 <- ggplot(Rod\_da, aes(x = collect\_number, fill = damage\_level)) +  
 geom\_bar(position = "stack") +  
 labs(title = "Frequency of damage level by week",  
 x = "Weeks", y = "Frequency") +  
 common\_theme  
  
# Arrange plots in a 2x2 grid  
grid.arrange(plot1, plot2, ncol = 2)



Note that the echo = FALSE parameter was added to the code chunk to prevent printing of the R code that generated the plot.