# Plant Population Iv\_2

CT, March 10, 2016

Purpose:

-Analysis of plant population – Iversen 2 (variable “Final Pop” seedlings per 1 sq meter)

- Design : Six cultivars, 3 block/reps, 8 sowing dates

EmergenceIv2

#create file  
df\_emerg <- read.table("PlantPop.txt",header=TRUE)  
  
# define factors   
df\_emerg$Plot <- as.factor(df\_emerg$Plot)  
df\_emerg$Block <- as.factor(df\_emerg$Block)  
  
 df\_emerg <- df\_emerg %>%  
 mutate(SowingDate = dmy(SowingDate),   
 ReadingDate = dmy(ReadingDate),  
 PlantPop = (Sub1+Sub2+Sub3)/3/0.01)  
  
str(df\_emerg)

## 'data.frame': 1494 obs. of 11 variables:  
## $ SowTreat : Factor w/ 8 levels "S1","S2","S3",..: 1 1 1 1 1 1 1 1 1 1 ...  
## $ Cultivar : Factor w/ 6 levels "Antas","Denmark",..: 1 4 2 3 5 6 1 6 2 4 ...  
## $ Block : Factor w/ 3 levels "1","2","3": 1 1 1 1 1 1 2 2 2 2 ...  
## $ Plot : Factor w/ 144 levels "1","2","3","4",..: 1 2 3 4 5 6 7 8 9 10 ...  
## $ SowingDate : Date, format: "2015-06-24" "2015-06-24" ...  
## $ ReadingDate: Date, format: "2015-06-24" "2015-06-24" ...  
## $ DAS : num 0 0 0 0 0 0 0 0 0 0 ...  
## $ Sub1 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Sub2 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ Sub3 : int 0 0 0 0 0 0 0 0 0 0 ...  
## $ PlantPop : num 0 0 0 0 0 0 0 0 0 0 ...

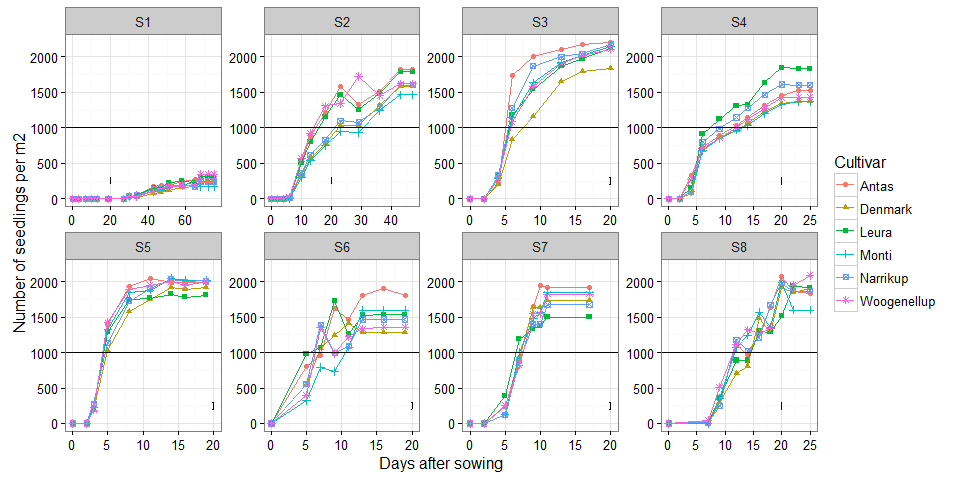
head(df\_emerg)

## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1 Sub2  
## 1 S1 Antas 1 1 2015-06-24 2015-06-24 0 0 0  
## 2 S1 Monti 1 2 2015-06-24 2015-06-24 0 0 0  
## 3 S1 Denmark 1 3 2015-06-24 2015-06-24 0 0 0  
## 4 S1 Leura 1 4 2015-06-24 2015-06-24 0 0 0  
## 5 S1 Narrikup 1 5 2015-06-24 2015-06-24 0 0 0  
## 6 S1 Woogenellup 1 6 2015-06-24 2015-06-24 0 0 0  
## Sub3 PlantPop  
## 1 0 0  
## 2 0 0  
## 3 0 0  
## 4 0 0  
## 5 0 0  
## 6 0 0

tail(df\_emerg)

## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1 Sub2  
## 1489 S8 Leura 3 139 2016-05-04 2016-05-29 25 19 17  
## 1490 S8 Monti 3 140 2016-05-04 2016-05-29 25 8 19  
## 1491 S8 Woogenellup 3 141 2016-05-04 2016-05-29 25 19 23  
## 1492 S8 Antas 3 142 2016-05-04 2016-05-29 25 15 21  
## 1493 S8 Denmark 3 143 2016-05-04 2016-05-29 25 14 20  
## 1494 S8 Narrikup 3 144 2016-05-04 2016-05-29 25 21 22  
## Sub3 PlantPop  
## 1489 18 1800.000  
## 1490 21 1600.000  
## 1491 11 1766.667  
## 1492 17 1766.667  
## 1493 25 1966.667  
## 1494 16 1966.667

Graph data



df\_emerg\_perc3 <- df\_emerg %>%  
group\_by(Plot) %>%  
mutate(FINALPOP = round(max(PlantPop)\*1,digits=2))  
  
head(df\_emerg\_perc3)

## Source: local data frame [6 x 12]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)

summary (df\_emerg\_perc3)

## SowTreat Cultivar Block Plot   
## S1 :306 Antas :249 1:498 1 : 17   
## S2 :216 Denmark :249 2:498 2 : 17   
## S4 :198 Leura :249 3:498 3 : 17   
## S8 :180 Monti :249 4 : 17   
## S5 :162 Narrikup :249 5 : 17   
## S3 :144 Woogenellup:249 6 : 17   
## (Other):288 (Other):1392   
## SowingDate ReadingDate DAS   
## Min. :2015-06-24 Min. :2015-06-24 Min. : 0.00   
## 1st Qu.:2015-07-28 1st Qu.:2015-08-21 1st Qu.: 5.00   
## Median :2015-11-05 Median :2015-11-14 Median :12.00   
## Mean :2015-11-06 Mean :2015-11-24 Mean :17.07   
## 3rd Qu.:2016-02-17 3rd Qu.:2016-03-01 3rd Qu.:20.00   
## Max. :2016-05-04 Max. :2016-05-29 Max. :75.00   
##   
  
##   
## FINALPOP   
## Min. : 166.7   
## 1st Qu.:1200.0   
## Median :1800.0   
## Mean :1502.6   
## 3rd Qu.:2066.7   
## Max. :2400.0   
##

write.table(df\_emerg\_perc3, "df\_emerg\_perc3.txt")

then select each sowing date individually for ANOVA

# ANOVAS

-with pure numbers;

- stats for each sowing date as a unique experiment

-Multiple comparisons using Fisher’s unprotected LSD test (Saville, 2015).

## Sowing Date 1

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S1")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S1 :306 Antas :51 1:102 1 : 17 Min. :2015-06-24   
## S2 : 0 Denmark :51 2:102 2 : 17 1st Qu.:2015-06-24   
## S3 : 0 Leura :51 3:102 3 : 17 Median :2015-06-24   
## S4 : 0 Monti :51 4 : 17 Mean :2015-06-24   
## S5 : 0 Narrikup :51 5 : 17 3rd Qu.:2015-06-24   
## S6 : 0 Woogenellup:51 6 : 17 Max. :2015-06-24   
## (Other): 0 (Other):204   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-06-24 Min. : 0.00 Min. :0.0000 Min. :0.000   
## 1st Qu.:2015-07-07 1st Qu.:13.00 1st Qu.:0.0000 1st Qu.:0.000   
## Median :2015-07-28 Median :34.00 Median :0.0000 Median :0.000   
## Mean :2015-07-30 Mean :36.59 Mean :0.8922 Mean :1.075   
## 3rd Qu.:2015-08-21 3rd Qu.:58.00 3rd Qu.:2.0000 3rd Qu.:2.000   
## Max. :2015-09-07 Max. :75.00 Max. :6.0000 Max. :6.000   
##   
## Sub3 PlantPop FINALPOP   
## Min. :0.0000 Min. : 0.00 Min. :166.7   
## 1st Qu.:0.0000 1st Qu.: 0.00 1st Qu.:233.3   
## Median :0.0000 Median : 33.33 Median :266.7   
## Mean :0.9967 Mean : 98.80 Mean :285.2   
## 3rd Qu.:2.0000 3rd Qu.:200.00 3rd Qu.:333.3   
## Max. :5.0000 Max. :533.33 Max. :533.3   
##

#data   
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

summary(file.subset)

Sub3 PlantPop FINALPOP transf\_no   
## Min. :0.0000 Min. : 0.00 Min. :166.7 Min. :166.7   
## 1st Qu.:0.0000 1st Qu.: 0.00 1st Qu.:233.3 1st Qu.:233.3   
## Median :0.0000 Median : 33.33 Median :266.7 Median :266.7   
## Mean :0.9967 Mean : 98.80 Mean :285.2 Mean :285.2   
## 3rd Qu.:2.0000 3rd Qu.:200.00 3rd Qu.:333.3 3rd Qu.:333.3   
## Max. :5.0000 Max. :533.33 Max. :533.3 Max. :533.3   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 398740 79748 23.79 <2e-16 \*\*\*  
## Block 2 763969 381985 113.94 <2e-16 \*\*\*  
## Residuals 298 999008 3352   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 285.1856 20.30246 3352.375 22.56429  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 298 6 1.967957 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 300.0000 72.72527 51 284.0446 315.9554 200.00 366.67  
## Denmark 244.4467 88.36010 51 228.4913 260.4020 166.67 366.67  
## Leura 311.1100 57.22173 51 295.1546 327.0654 233.33 366.67  
## Monti 255.5567 15.87301 51 239.6013 271.5120 233.33 266.67  
## Narrikup 255.5567 15.87301 51 239.6013 271.5120 233.33 266.67  
## Woogenellup 344.4433 135.59068 51 328.4880 360.3987 233.33 533.33  
##   
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Woogenellup 344.4433 a  
## 2 Leura 311.1100 b  
## 3 Antas 300.0000 b  
## 4 Monti 255.5567 c  
## 5 Narrikup 255.5567 c  
## 6 Denmark 244.4467 c

#(LSD.test(my.anova, "Cultivar"))

Notes: reasons for bad establishment in S1:

- lack of seed compactation. With wet soils in June was not possible to roll the plots

- winter low temperatures; wet soil!

- insect /bird predation

## Sowing Date 2

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S2")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S2 :216 Antas :36 1:72 19 : 12 Min. :2015-07-28   
## S1 : 0 Denmark :36 2:72 20 : 12 1st Qu.:2015-07-28   
## S3 : 0 Leura :36 3:72 21 : 12 Median :2015-07-28   
## S4 : 0 Monti :36 22 : 12 Mean :2015-07-28   
## S5 : 0 Narrikup :36 23 : 12 3rd Qu.:2015-07-28   
## S6 : 0 Woogenellup:36 24 : 12 Max. :2015-07-28   
## (Other): 0 (Other):144   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-07-28 Min. : 0.00 Min. : 0.000 Min. : 0.000   
## 1st Qu.:2015-08-02 1st Qu.: 5.50 1st Qu.: 0.000 1st Qu.: 0.000   
## Median :2015-08-12 Median :15.50 Median : 7.000 Median : 8.000   
## Mean :2015-08-16 Mean :19.25 Mean : 7.097 Mean : 8.046   
## 3rd Qu.:2015-08-27 3rd Qu.:30.75 3rd Qu.:12.000 3rd Qu.:14.000   
## Max. :2015-09-13 Max. :47.00 Max. :22.000 Max. :27.000   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.000 Min. : 0.0 Min. : 966.7   
## 1st Qu.: 0.000 1st Qu.: 0.0 1st Qu.:1533.3   
## Median : 8.000 Median : 766.7 Median :1700.0   
## Mean : 8.134 Mean : 775.9 Mean :1696.3   
## 3rd Qu.:15.000 3rd Qu.:1400.0 3rd Qu.:1900.0   
## Max. :29.000 Max. :2100.0 Max. :2100.0   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S2 Narrikup 1 19 2015-07-28 2015-07-28 0 0  
## 2 S2 Monti 1 20 2015-07-28 2015-07-28 0 0  
## 3 S2 Woogenellup 1 21 2015-07-28 2015-07-28 0 0  
## 4 S2 Leura 1 22 2015-07-28 2015-07-28 0 0  
## 5 S2 Denmark 1 23 2015-07-28 2015-07-28 0 0  
## 6 S2 Antas 1 24 2015-07-28 2015-07-28 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S2 Narrikup 1 19 2015-07-28 2015-07-28 0 0  
## 2 S2 Monti 1 20 2015-07-28 2015-07-28 0 0  
## 3 S2 Woogenellup 1 21 2015-07-28 2015-07-28 0 0  
## 4 S2 Leura 1 22 2015-07-28 2015-07-28 0 0  
## 5 S2 Denmark 1 23 2015-07-28 2015-07-28 0 0  
## 6 S2 Antas 1 24 2015-07-28 2015-07-28 0 0  
## 7 S2 Leura 2 25 2015-07-28 2015-07-28 0 0  
## 8 S2 Woogenellup 2 26 2015-07-28 2015-07-28 0 0  
## 9 S2 Denmark 2 27 2015-07-28 2015-07-28 0 0  
## 10 S2 Narrikup 2 28 2015-07-28 2015-07-28 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S2 :216 Antas :36 1:72 19 : 12 Min. :2015-07-28   
## S1 : 0 Denmark :36 2:72 20 : 12 1st Qu.:2015-07-28   
## S3 : 0 Leura :36 3:72 21 : 12 Median :2015-07-28   
## S4 : 0 Monti :36 22 : 12 Mean :2015-07-28   
## S5 : 0 Narrikup :36 23 : 12 3rd Qu.:2015-07-28   
## S6 : 0 Woogenellup:36 24 : 12 Max. :2015-07-28   
## (Other): 0 (Other):144   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-07-28 Min. : 0.00 Min. : 0.000 Min. : 0.000   
## 1st Qu.:2015-08-02 1st Qu.: 5.50 1st Qu.: 0.000 1st Qu.: 0.000   
## Median :2015-08-12 Median :15.50 Median : 7.000 Median : 8.000   
## Mean :2015-08-16 Mean :19.25 Mean : 7.097 Mean : 8.046   
## 3rd Qu.:2015-08-27 3rd Qu.:30.75 3rd Qu.:12.000 3rd Qu.:14.000   
## Max. :2015-09-13 Max. :47.00 Max. :22.000 Max. :27.000   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.000 Min. : 0.0 Min. : 966.7 Min. : 966.7   
## 1st Qu.: 0.000 1st Qu.: 0.0 1st Qu.:1533.3 1st Qu.:1533.3   
## Median : 8.000 Median : 766.7 Median :1700.0 Median :1700.0   
## Mean : 8.134 Mean : 775.9 Mean :1696.3 Mean :1696.3   
## 3rd Qu.:15.000 3rd Qu.:1400.0 3rd Qu.:1900.0 3rd Qu.:1900.0   
## Max. :29.000 Max. :2100.0 Max. :2100.0 Max. :2100.0   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 5294776 1058955 18.38 4.24e-15 \*\*\*  
## Block 2 2957018 1478509 25.66 1.10e-10 \*\*\*  
## Residuals 208 11985245 57621   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 1696.298 14.15108 57621.37 111.5419  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 208 6 1.971435 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 1888.890 254.98529 36 1810.018 1967.762 1533.33 2066.67  
## Denmark 1577.780 152.02247 36 1498.908 1656.652 1366.67 1700.00  
## Leura 1788.890 69.46636 36 1710.018 1867.762 1700.00 1866.67  
## Monti 1466.670 379.47332 36 1387.798 1545.542 966.67 1866.67  
## Narrikup 1600.000 389.38183 36 1521.128 1678.872 1166.67 2100.00  
## Woogenellup 1855.557 195.83077 36 1776.685 1934.429 1600.00 2066.67  
##   
## $comparison  
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Antas 1888.890 a  
## 2 Woogenellup 1855.557 a  
## 3 Leura 1788.890 a  
## 4 Narrikup 1600.000 b  
## 5 Denmark 1577.780 bc  
## 6 Monti 1466.670 c

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 3

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S3")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S3 :144 Antas :24 1:48 37 : 8 Min. :2015-09-15   
## S1 : 0 Denmark :24 2:48 38 : 8 1st Qu.:2015-09-15   
## S2 : 0 Leura :24 3:48 39 : 8 Median :2015-09-15   
## S4 : 0 Monti :24 40 : 8 Mean :2015-09-15   
## S5 : 0 Narrikup :24 41 : 8 3rd Qu.:2015-09-15   
## S6 : 0 Woogenellup:24 42 : 8 Max. :2015-09-15   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-09-15 Min. : 0.00 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2015-09-18 1st Qu.: 3.50 1st Qu.: 0.75 1st Qu.: 0.75   
## Median :2015-09-22 Median : 7.50 Median :14.00 Median :15.00   
## Mean :2015-09-23 Mean : 8.75 Mean :11.70 Mean :11.63   
## 3rd Qu.:2015-09-28 3rd Qu.:13.75 3rd Qu.:20.00 3rd Qu.:20.00   
## Max. :2015-10-05 Max. :20.00 Max. :26.00 Max. :25.00   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.00 Min. : 0 Min. :1433   
## 1st Qu.: 0.00 1st Qu.: 75 1st Qu.:2067   
## Median :13.50 Median :1317 Median :2167   
## Mean :10.92 Mean :1142 Mean :2098   
## 3rd Qu.:20.00 3rd Qu.:2008 3rd Qu.:2167   
## Max. :24.00 Max. :2233 Max. :2233   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S3 Denmark 1 37 2015-09-15 2015-09-15 0 0  
## 2 S3 Antas 1 38 2015-09-15 2015-09-15 0 0  
## 3 S3 Woogenellup 1 39 2015-09-15 2015-09-15 0 0  
## 4 S3 Leura 1 40 2015-09-15 2015-09-15 0 0  
## 5 S3 Narrikup 1 41 2015-09-15 2015-09-15 0 0  
## 6 S3 Monti 1 42 2015-09-15 2015-09-15 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S3 Denmark 1 37 2015-09-15 2015-09-15 0 0  
## 2 S3 Antas 1 38 2015-09-15 2015-09-15 0 0  
## 3 S3 Woogenellup 1 39 2015-09-15 2015-09-15 0 0  
## 4 S3 Leura 1 40 2015-09-15 2015-09-15 0 0  
## 5 S3 Narrikup 1 41 2015-09-15 2015-09-15 0 0  
## 6 S3 Monti 1 42 2015-09-15 2015-09-15 0 0  
## 7 S3 Woogenellup 2 43 2015-09-15 2015-09-15 0 0  
## 8 S3 Leura 2 44 2015-09-15 2015-09-15 0 0  
## 9 S3 Narrikup 2 45 2015-09-15 2015-09-15 0 0  
## 10 S3 Antas 2 46 2015-09-15 2015-09-15 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S3 :144 Antas :24 1:48 37 : 8 Min. :2015-09-15   
## S1 : 0 Denmark :24 2:48 38 : 8 1st Qu.:2015-09-15   
## S2 : 0 Leura :24 3:48 39 : 8 Median :2015-09-15   
## S4 : 0 Monti :24 40 : 8 Mean :2015-09-15   
## S5 : 0 Narrikup :24 41 : 8 3rd Qu.:2015-09-15   
## S6 : 0 Woogenellup:24 42 : 8 Max. :2015-09-15   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-09-15 Min. : 0.00 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2015-09-18 1st Qu.: 3.50 1st Qu.: 0.75 1st Qu.: 0.75   
## Median :2015-09-22 Median : 7.50 Median :14.00 Median :15.00   
## Mean :2015-09-23 Mean : 8.75 Mean :11.70 Mean :11.63   
## 3rd Qu.:2015-09-28 3rd Qu.:13.75 3rd Qu.:20.00 3rd Qu.:20.00   
## Max. :2015-10-05 Max. :20.00 Max. :26.00 Max. :25.00   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.00 Min. : 0 Min. :1433 Min. :1433   
## 1st Qu.: 0.00 1st Qu.: 75 1st Qu.:2067 1st Qu.:2067   
## Median :13.50 Median :1317 Median :2167 Median :2167   
## Mean :10.92 Mean :1142 Mean :2098 Mean :2098   
## 3rd Qu.:20.00 3rd Qu.:2008 3rd Qu.:2167 3rd Qu.:2167   
## Max. :24.00 Max. :2233 Max. :2233 Max. :2233   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 2153637 430727 28.501 < 2e-16 \*\*\*  
## Block 2 243944 121972 8.071 0.000487 \*\*\*  
## Residuals 136 2055313 15113   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 2098.148 5.859132 15112.59 70.17925  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 136 6 1.977561 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 2200.000 27.79914 24 2150.376 2249.624 2166.67 2233.33  
## Denmark 1833.330 300.72376 24 1783.706 1882.954 1433.33 2133.33  
## Leura 2122.223 64.20900 24 2072.599 2171.848 2033.33 2166.67  
## Monti 2144.447 57.87320 24 2094.822 2194.071 2066.67 2200.00  
## Narrikup 2177.780 16.04984 24 2128.156 2227.404 2166.67 2200.00  
## Woogenellup 2111.110 32.09968 24 2061.486 2160.734 2066.67 2133.33  
##   
## $comparison  
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Antas 2200.000 a  
## 2 Narrikup 2177.780 ab  
## 3 Monti 2144.447 ab  
## 4 Leura 2122.223 b  
## 5 Woogenellup 2111.110 b  
## 6 Denmark 1833.330 c

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 4

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S4")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S4 :198 Antas :33 1:66 55 : 11 Min. :2015-11-05   
## S1 : 0 Denmark :33 2:66 56 : 11 1st Qu.:2015-11-05   
## S2 : 0 Leura :33 3:66 57 : 11 Median :2015-11-05   
## S3 : 0 Monti :33 58 : 11 Mean :2015-11-05   
## S5 : 0 Narrikup :33 59 : 11 3rd Qu.:2015-11-05   
## S6 : 0 Woogenellup:33 60 : 11 Max. :2015-11-05   
## (Other): 0 (Other):132   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-11-05 Min. : 0 Min. : 0.000 Min. : 0.000   
## 1st Qu.:2015-11-09 1st Qu.: 4 1st Qu.: 2.500 1st Qu.: 3.000   
## Median :2015-11-17 Median :12 Median :10.000 Median :10.000   
## Mean :2015-11-17 Mean :12 Mean : 9.939 Mean : 9.237   
## 3rd Qu.:2015-11-25 3rd Qu.:20 3rd Qu.:14.000 3rd Qu.:14.000   
## Max. :2015-11-30 Max. :25 Max. :28.000 Max. :21.000   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.000 Min. : 0.0 Min. :1067   
## 1st Qu.: 2.000 1st Qu.: 208.3 1st Qu.:1267   
## Median : 9.000 Median :1000.0 Median :1433   
## Mean : 8.035 Mean : 907.1 Mean :1530   
## 3rd Qu.:12.000 3rd Qu.:1333.3 3rd Qu.:1900   
## Max. :20.000 Max. :2033.3 Max. :2033   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S4 Narrikup 1 55 2015-11-05 2015-11-05 0 0  
## 2 S4 Antas 1 56 2015-11-05 2015-11-05 0 0  
## 3 S4 Denmark 1 57 2015-11-05 2015-11-05 0 0  
## 4 S4 Leura 1 58 2015-11-05 2015-11-05 0 0  
## 5 S4 Monti 1 59 2015-11-05 2015-11-05 0 0  
## 6 S4 Woogenellup 1 60 2015-11-05 2015-11-05 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S4 Narrikup 1 55 2015-11-05 2015-11-05 0 0  
## 2 S4 Antas 1 56 2015-11-05 2015-11-05 0 0  
## 3 S4 Denmark 1 57 2015-11-05 2015-11-05 0 0  
## 4 S4 Leura 1 58 2015-11-05 2015-11-05 0 0  
## 5 S4 Monti 1 59 2015-11-05 2015-11-05 0 0  
## 6 S4 Woogenellup 1 60 2015-11-05 2015-11-05 0 0  
## 7 S4 Antas 2 61 2015-11-05 2015-11-05 0 0  
## 8 S4 Woogenellup 2 62 2015-11-05 2015-11-05 0 0  
## 9 S4 Narrikup 2 63 2015-11-05 2015-11-05 0 0  
## 10 S4 Leura 2 64 2015-11-05 2015-11-05 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S4 :198 Antas :33 1:66 55 : 11 Min. :2015-11-05   
## S1 : 0 Denmark :33 2:66 56 : 11 1st Qu.:2015-11-05   
## S2 : 0 Leura :33 3:66 57 : 11 Median :2015-11-05   
## S3 : 0 Monti :33 58 : 11 Mean :2015-11-05   
## S5 : 0 Narrikup :33 59 : 11 3rd Qu.:2015-11-05   
## S6 : 0 Woogenellup:33 60 : 11 Max. :2015-11-05   
## (Other): 0 (Other):132   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-11-05 Min. : 0 Min. : 0.000 Min. : 0.000   
## 1st Qu.:2015-11-09 1st Qu.: 4 1st Qu.: 2.500 1st Qu.: 3.000   
## Median :2015-11-17 Median :12 Median :10.000 Median :10.000   
## Mean :2015-11-17 Mean :12 Mean : 9.939 Mean : 9.237   
## 3rd Qu.:2015-11-25 3rd Qu.:20 3rd Qu.:14.000 3rd Qu.:14.000   
## Max. :2015-11-30 Max. :25 Max. :28.000 Max. :21.000   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.000 Min. : 0.0 Min. :1067 Min. :1067   
## 1st Qu.: 2.000 1st Qu.: 208.3 1st Qu.:1267 1st Qu.:1267   
## Median : 9.000 Median :1000.0 Median :1433 Median :1433   
## Mean : 8.035 Mean : 907.1 Mean :1530 Mean :1530   
## 3rd Qu.:12.000 3rd Qu.:1333.3 3rd Qu.:1900 3rd Qu.:1900   
## Max. :20.000 Max. :2033.3 Max. :2033 Max. :2033   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 5570571 1114114 15.141 1.64e-12 \*\*\*  
## Block 2 856919 428460 5.823 0.00351 \*\*   
## Residuals 190 13980721 73583   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 1529.63 17.73379 73582.74 131.7253  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 190 6 1.972528 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 1522.223 329.73909 33 1429.079 1615.367 1200.00 1966.67  
## Denmark 1377.780 84.43683 33 1284.636 1470.924 1266.67 1466.67  
## Leura 1844.443 184.02529 33 1751.299 1937.587 1600.00 2033.33  
## Monti 1366.667 280.49782 33 1273.523 1459.811 1066.67 1733.33  
## Narrikup 1633.333 318.74044 33 1540.189 1726.477 1266.67 2033.33  
## Woogenellup 1433.333 365.62143 33 1340.189 1526.477 1100.00 1933.33  
##   
## $comparison  
## NULL  
##$groups  
## Cultivar means M  
## 1 Leura 1844.443 a  
## 2 Narrikup 1633.333 b  
## 3 Antas 1522.223 bc  
## 4 Woogenellup 1433.333 cd  
## 5 Denmark 1377.780 d  
## 6 Monti 1366.667 d

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 5

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S5")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S5 :162 Antas :27 1:54 73 : 9 Min. :2015-12-15   
## S1 : 0 Denmark :27 2:54 74 : 9 1st Qu.:2015-12-15   
## S2 : 0 Leura :27 3:54 75 : 9 Median :2015-12-15   
## S3 : 0 Monti :27 76 : 9 Mean :2015-12-15   
## S4 : 0 Narrikup :27 77 : 9 3rd Qu.:2015-12-15   
## S6 : 0 Woogenellup:27 78 : 9 Max. :2015-12-15   
## (Other): 0 (Other):108   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-12-15 Min. : 0.000 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2015-12-18 1st Qu.: 3.000 1st Qu.: 2.00 1st Qu.: 2.00   
## Median :2015-12-23 Median : 8.000 Median :14.00 Median :15.00   
## Mean :2015-12-23 Mean : 8.667 Mean :11.69 Mean :12.12   
## 3rd Qu.:2015-12-29 3rd Qu.:14.000 3rd Qu.:18.00 3rd Qu.:19.75   
## Max. :2016-01-03 Max. :19.000 Max. :25.00 Max. :26.00   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.00 Min. : 0 Min. :1667   
## 1st Qu.: 2.00 1st Qu.: 175 1st Qu.:1867   
## Median :16.00 Median :1600 Median :2017   
## Mean :12.88 Mean :1223 Mean :2022   
## 3rd Qu.:21.00 3rd Qu.:1933 3rd Qu.:2167   
## Max. :27.00 Max. :2333 Max. :2333   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S5 Woogenellup 1 73 2015-12-15 2015-12-15 0 0  
## 2 S5 Leura 1 74 2015-12-15 2015-12-15 0 0  
## 3 S5 Antas 1 75 2015-12-15 2015-12-15 0 0  
## 4 S5 Narrikup 1 76 2015-12-15 2015-12-15 0 0  
## 5 S5 Monti 1 77 2015-12-15 2015-12-15 0 0  
## 6 S5 Denmark 1 78 2015-12-15 2015-12-15 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S5 Woogenellup 1 73 2015-12-15 2015-12-15 0 0  
## 2 S5 Leura 1 74 2015-12-15 2015-12-15 0 0  
## 3 S5 Antas 1 75 2015-12-15 2015-12-15 0 0  
## 4 S5 Narrikup 1 76 2015-12-15 2015-12-15 0 0  
## 5 S5 Monti 1 77 2015-12-15 2015-12-15 0 0  
## 6 S5 Denmark 1 78 2015-12-15 2015-12-15 0 0  
## 7 S5 Denmark 2 79 2015-12-15 2015-12-15 0 0  
## 8 S5 Monti 2 80 2015-12-15 2015-12-15 0 0  
## 9 S5 Leura 2 81 2015-12-15 2015-12-15 0 0  
## 10 S5 Woogenellup 2 82 2015-12-15 2015-12-15 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S5 :162 Antas :27 1:54 73 : 9 Min. :2015-12-15   
## S1 : 0 Denmark :27 2:54 74 : 9 1st Qu.:2015-12-15   
## S2 : 0 Leura :27 3:54 75 : 9 Median :2015-12-15   
## S3 : 0 Monti :27 76 : 9 Mean :2015-12-15   
## S4 : 0 Narrikup :27 77 : 9 3rd Qu.:2015-12-15   
## S6 : 0 Woogenellup:27 78 : 9 Max. :2015-12-15   
## (Other): 0 (Other):108   
## ReadingDate DAS Sub1 Sub2   
## Min. :2015-12-15 Min. : 0.000 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2015-12-18 1st Qu.: 3.000 1st Qu.: 2.00 1st Qu.: 2.00   
## Median :2015-12-23 Median : 8.000 Median :14.00 Median :15.00   
## Mean :2015-12-23 Mean : 8.667 Mean :11.69 Mean :12.12   
## 3rd Qu.:2015-12-29 3rd Qu.:14.000 3rd Qu.:18.00 3rd Qu.:19.75   
## Max. :2016-01-03 Max. :19.000 Max. :25.00 Max. :26.00   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.00 Min. : 0 Min. :1667 Min. :1667   
## 1st Qu.: 2.00 1st Qu.: 175 1st Qu.:1867 1st Qu.:1867   
## Median :16.00 Median :1600 Median :2017 Median :2017   
## Mean :12.88 Mean :1223 Mean :2022 Mean :2022   
## 3rd Qu.:21.00 3rd Qu.:1933 3rd Qu.:2167 3rd Qu.:2167   
## Max. :27.00 Max. :2333 Max. :2333 Max. :2333   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 806653 161331 10.60 9.13e-09 \*\*\*  
## Block 2 2830000 1415000 92.99 < 2e-16 \*\*\*  
## Residuals 154 2343305 15216   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 2022.222 6.099934 15216.26 66.3226  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 154 6 1.975488 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 2077.777 115.46783 27 2030.880 2124.674 1966.67 2233.33  
## Denmark 1922.223 80.06087 27 1875.326 1969.120 1866.67 2033.33  
## Leura 1933.333 273.15746 27 1886.436 1980.230 1666.67 2300.00  
## Monti 2044.443 224.17793 27 1997.546 2091.340 1800.00 2333.33  
## Narrikup 2044.447 176.14257 27 1997.550 2091.344 1800.00 2166.67  
## Woogenellup 2111.110 152.75387 27 2064.213 2158.007 1933.33 2300.00  
##   
## $comparison  
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Woogenellup 2111.110 a  
## 2 Antas 2077.777 ab  
## 3 Narrikup 2044.447 b  
## 4 Monti 2044.443 b  
## 5 Leura 1933.333 c  
## 6 Denmark 1922.223 c

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 6

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S6")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S6 :144 Antas :24 1:48 91 : 8 Min. :2016-02-17   
## S1 : 0 Denmark :24 2:48 92 : 8 1st Qu.:2016-02-17   
## S2 : 0 Leura :24 3:48 93 : 8 Median :2016-02-17   
## S3 : 0 Monti :24 94 : 8 Mean :2016-02-17   
## S4 : 0 Narrikup :24 95 : 8 3rd Qu.:2016-02-17   
## S5 : 0 Woogenellup:24 96 : 8 Max. :2016-02-17   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-02-17 Min. : 0.00 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2016-02-23 1st Qu.: 6.50 1st Qu.: 7.00 1st Qu.: 7.00   
## Median :2016-02-27 Median :10.00 Median :12.00 Median :11.00   
## Mean :2016-02-27 Mean :10.00 Mean :10.59 Mean :10.58   
## 3rd Qu.:2016-03-01 3rd Qu.:13.75 3rd Qu.:14.00 3rd Qu.:15.00   
## Max. :2016-03-07 Max. :19.00 Max. :23.00 Max. :22.00   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.00 Min. : 0 Min. :1133   
## 1st Qu.: 8.00 1st Qu.: 825 1st Qu.:1367   
## Median :12.00 Median :1133 Median :1533   
## Mean :11.48 Mean :1088 Mean :1604   
## 3rd Qu.:16.00 3rd Qu.:1533 3rd Qu.:1833   
## Max. :26.00 Max. :2167 Max. :2167   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S6 Denmark 1 91 2016-02-17 2016-02-17 0 0  
## 2 S6 Monti 1 92 2016-02-17 2016-02-17 0 0  
## 3 S6 Woogenellup 1 93 2016-02-17 2016-02-17 0 0  
## 4 S6 Leura 1 94 2016-02-17 2016-02-17 0 0  
## 5 S6 Antas 1 95 2016-02-17 2016-02-17 0 0  
## 6 S6 Narrikup 1 96 2016-02-17 2016-02-17 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S6 Denmark 1 91 2016-02-17 2016-02-17 0 0  
## 2 S6 Monti 1 92 2016-02-17 2016-02-17 0 0  
## 3 S6 Woogenellup 1 93 2016-02-17 2016-02-17 0 0  
## 4 S6 Leura 1 94 2016-02-17 2016-02-17 0 0  
## 5 S6 Antas 1 95 2016-02-17 2016-02-17 0 0  
## 6 S6 Narrikup 1 96 2016-02-17 2016-02-17 0 0  
## 7 S6 Leura 2 97 2016-02-17 2016-02-17 0 0  
## 8 S6 Monti 2 98 2016-02-17 2016-02-17 0 0  
## 9 S6 Woogenellup 2 99 2016-02-17 2016-02-17 0 0  
## 10 S6 Denmark 2 100 2016-02-17 2016-02-17 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S6 :144 Antas :24 1:48 91 : 8 Min. :2016-02-17   
## S1 : 0 Denmark :24 2:48 92 : 8 1st Qu.:2016-02-17   
## S2 : 0 Leura :24 3:48 93 : 8 Median :2016-02-17   
## S3 : 0 Monti :24 94 : 8 Mean :2016-02-17   
## S4 : 0 Narrikup :24 95 : 8 3rd Qu.:2016-02-17   
## S5 : 0 Woogenellup:24 96 : 8 Max. :2016-02-17   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-02-17 Min. : 0.00 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2016-02-23 1st Qu.: 6.50 1st Qu.: 7.00 1st Qu.: 7.00   
## Median :2016-02-27 Median :10.00 Median :12.00 Median :11.00   
## Mean :2016-02-27 Mean :10.00 Mean :10.59 Mean :10.58   
## 3rd Qu.:2016-03-01 3rd Qu.:13.75 3rd Qu.:14.00 3rd Qu.:15.00   
## Max. :2016-03-07 Max. :19.00 Max. :23.00 Max. :22.00   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.00 Min. : 0 Min. :1133 Min. :1133   
## 1st Qu.: 8.00 1st Qu.: 825 1st Qu.:1367 1st Qu.:1367   
## Median :12.00 Median :1133 Median :1533 Median :1533   
## Mean :11.48 Mean :1088 Mean :1604 Mean :1604   
## 3rd Qu.:16.00 3rd Qu.:1533 3rd Qu.:1833 3rd Qu.:1833   
## Max. :26.00 Max. :2167 Max. :2167 Max. :2167   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 4134330 826866 12.40 6.48e-10 \*\*\*  
## Block 2 178756 89378 1.34 0.265   
## Residuals 136 9071648 66703   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 1603.703 16.10459 66703.3 147.4392  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 136 6 1.977561 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 1900.000 147.1134 24 1795.745 2004.255 1766.67 2100.00  
## Denmark 1455.557 299.8674 24 1351.301 1559.812 1200.00 1866.67  
## Leura 1722.220 264.2388 24 1617.965 1826.475 1400.00 2033.33  
## Monti 1622.223 405.1224 24 1517.968 1726.479 1233.33 2166.67  
## Narrikup 1522.223 139.9320 24 1417.968 1626.479 1366.67 1700.00  
## Woogenellup 1399.997 192.6174 24 1295.741 1504.252 1133.33 1533.33  
##   
## $comparison  
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Antas 1900.000 a  
## 2 Leura 1722.220 b  
## 3 Monti 1622.223 bc  
## 4 Narrikup 1522.223 cd  
## 5 Denmark 1455.557 d  
## 6 Woogenellup 1399.997 d

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 7

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S7")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S7 :144 Antas :24 1:48 109 : 8 Min. :2016-03-15   
## S1 : 0 Denmark :24 2:48 110 : 8 1st Qu.:2016-03-15   
## S2 : 0 Leura :24 3:48 111 : 8 Median :2016-03-15   
## S3 : 0 Monti :24 112 : 8 Mean :2016-03-15   
## S4 : 0 Narrikup :24 113 : 8 3rd Qu.:2016-03-15   
## S5 : 0 Woogenellup:24 114 : 8 Max. :2016-03-15   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-03-15 Min. : 0.000 Min. : 0.000 Min. : 0.00   
## 1st Qu.:2016-03-19 1st Qu.: 4.250 1st Qu.: 0.000 1st Qu.: 0.00   
## Median :2016-03-23 Median : 8.000 Median : 9.000 Median :11.00   
## Mean :2016-03-22 Mean : 7.611 Mean : 9.201 Mean :10.08   
## 3rd Qu.:2016-03-25 3rd Qu.:10.250 3rd Qu.:15.000 3rd Qu.:17.25   
## Max. :2016-04-01 Max. :17.000 Max. :28.000 Max. :26.00   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.000 Min. : 0 Min. :1200   
## 1st Qu.: 0.000 1st Qu.: 25 1st Qu.:1533   
## Median :11.000 Median :1067 Median :1800   
## Mean : 9.792 Mean : 969 Mean :1759   
## 3rd Qu.:17.000 3rd Qu.:1667 3rd Qu.:1900   
## Max. :24.000 Max. :2167 Max. :2167   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S7 Denmark 1 109 2016-03-15 2016-03-15 0 0  
## 2 S7 Antas 1 110 2016-03-15 2016-03-15 0 0  
## 3 S7 Woogenellup 1 111 2016-03-15 2016-03-15 0 0  
## 4 S7 Leura 1 112 2016-03-15 2016-03-15 0 0  
## 5 S7 Narrikup 1 113 2016-03-15 2016-03-15 0 0  
## 6 S7 Monti 1 114 2016-03-15 2016-03-15 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S7 Denmark 1 109 2016-03-15 2016-03-15 0 0  
## 2 S7 Antas 1 110 2016-03-15 2016-03-15 0 0  
## 3 S7 Woogenellup 1 111 2016-03-15 2016-03-15 0 0  
## 4 S7 Leura 1 112 2016-03-15 2016-03-15 0 0  
## 5 S7 Narrikup 1 113 2016-03-15 2016-03-15 0 0  
## 6 S7 Monti 1 114 2016-03-15 2016-03-15 0 0  
## 7 S7 Woogenellup 2 115 2016-03-15 2016-03-15 0 0  
## 8 S7 Leura 2 116 2016-03-15 2016-03-15 0 0  
## 9 S7 Narrikup 2 117 2016-03-15 2016-03-15 0 0  
## 10 S7 Antas 2 118 2016-03-15 2016-03-15 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S7 :144 Antas :24 1:48 109 : 8 Min. :2016-03-15   
## S1 : 0 Denmark :24 2:48 110 : 8 1st Qu.:2016-03-15   
## S2 : 0 Leura :24 3:48 111 : 8 Median :2016-03-15   
## S3 : 0 Monti :24 112 : 8 Mean :2016-03-15   
## S4 : 0 Narrikup :24 113 : 8 3rd Qu.:2016-03-15   
## S5 : 0 Woogenellup:24 114 : 8 Max. :2016-03-15   
## (Other): 0 (Other):96   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-03-15 Min. : 0.000 Min. : 0.000 Min. : 0.00   
## 1st Qu.:2016-03-19 1st Qu.: 4.250 1st Qu.: 0.000 1st Qu.: 0.00   
## Median :2016-03-23 Median : 8.000 Median : 9.000 Median :11.00   
## Mean :2016-03-22 Mean : 7.611 Mean : 9.201 Mean :10.08   
## 3rd Qu.:2016-03-25 3rd Qu.:10.250 3rd Qu.:15.000 3rd Qu.:17.25   
## Max. :2016-04-01 Max. :17.000 Max. :28.000 Max. :26.00   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.000 Min. : 0 Min. :1200 Min. :1200   
## 1st Qu.: 0.000 1st Qu.: 25 1st Qu.:1533 1st Qu.:1533   
## Median :11.000 Median :1067 Median :1800 Median :1800   
## Mean : 9.792 Mean : 969 Mean :1759 Mean :1759   
## 3rd Qu.:17.000 3rd Qu.:1667 3rd Qu.:1900 3rd Qu.:1900   
## Max. :24.000 Max. :2167 Max. :2167 Max. :2167   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 3203991 640798 15.87 2.70e-12 \*\*\*  
## Block 2 1589155 794577 19.68 3.13e-08 \*\*\*  
## Residuals 136 5492388 40385   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 1759.26 11.42302 40385.2 114.723  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 136 6 1.977561 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 1977.780 128.4132 24 1896.659 2058.901 1800.00 2066.67  
## Denmark 1733.333 173.6229 24 1652.212 1814.455 1500.00 1900.00  
## Leura 1500.000 250.2173 24 1418.879 1581.121 1200.00 1800.00  
## Monti 1844.447 252.2685 24 1763.325 1925.568 1566.67 2166.67  
## Narrikup 1677.777 252.2699 24 1596.655 1758.898 1333.33 1900.00  
## Woogenellup 1822.223 267.1518 24 1741.102 1903.345 1533.33 2166.67  
##   
## $comparison  
## NULL  
##   
## $groups  
## Cultivar means M  
## 1 Antas 1977.780 a  
## 2 Monti 1844.447 b  
## 3 Woogenellup 1822.223 b  
## 4 Denmark 1733.333 bc  
## 5 Narrikup 1677.777 c  
## 6 Leura 1500.000 d

#(LSD.test(my.anova, "Cultivar"))

## Sowing Date 8

df\_emerg\_S1 <-df\_emerg\_perc3 %>%  
filter(SowTreat=="S8")   
summary (df\_emerg\_S1)

## SowTreat Cultivar Block Plot SowingDate   
## S8 :180 Antas :30 1:60 127 : 10 Min. :2016-05-04   
## S1 : 0 Denmark :30 2:60 128 : 10 1st Qu.:2016-05-04   
## S2 : 0 Leura :30 3:60 129 : 10 Median :2016-05-04   
## S3 : 0 Monti :30 130 : 10 Mean :2016-05-04   
## S4 : 0 Narrikup :30 131 : 10 3rd Qu.:2016-05-04   
## S5 : 0 Woogenellup:30 132 : 10 Max. :2016-05-04   
## (Other): 0 (Other):120   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-05-04 Min. : 0.0 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2016-05-13 1st Qu.: 9.0 1st Qu.: 3.00 1st Qu.: 3.00   
## Median :2016-05-19 Median :15.0 Median :12.00 Median :12.00   
## Mean :2016-05-18 Mean :14.3 Mean :10.95 Mean :11.02   
## 3rd Qu.:2016-05-24 3rd Qu.:20.0 3rd Qu.:17.25 3rd Qu.:17.00   
## Max. :2016-05-29 Max. :25.0 Max. :28.00 Max. :28.00   
##   
## Sub3 PlantPop FINALPOP   
## Min. : 0.00 Min. : 0.0 Min. :1833   
## 1st Qu.: 2.00 1st Qu.: 333.3 1st Qu.:1900   
## Median :12.00 Median :1200.0 Median :2083   
## Mean :10.58 Mean :1084.8 Mean :2080   
## 3rd Qu.:17.00 3rd Qu.:1766.7 3rd Qu.:2233   
## Max. :28.00 Max. :2400.0 Max. :2400   
##

#data transf  
file <- df\_emerg\_S1  
file$transf\_no <- 1\*(df\_emerg\_S1$FINALPOP )  
head(file)

## Source: local data frame [6 x 13]  
## Groups: Plot [6]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S8 Antas 1 127 2016-05-04 2016-05-04 0 0  
## 2 S8 Leura 1 128 2016-05-04 2016-05-04 0 0  
## 3 S8 Denmark 1 129 2016-05-04 2016-05-04 0 0  
## 4 S8 Monti 1 130 2016-05-04 2016-05-04 0 0  
## 5 S8 Narrikup 1 131 2016-05-04 2016-05-04 0 0  
## 6 S8 Woogenellup 1 132 2016-05-04 2016-05-04 0 0  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

#-------------------------------------------------  
# ANOVA   
file.subset <- file   
  
head(file.subset, 50)

## Source: local data frame [50 x 13]  
## Groups: Plot [18]  
##   
## SowTreat Cultivar Block Plot SowingDate ReadingDate DAS Sub1  
## (fctr) (fctr) (fctr) (fctr) (date) (date) (dbl) (int)  
## 1 S8 Antas 1 127 2016-05-04 2016-05-04 0 0  
## 2 S8 Leura 1 128 2016-05-04 2016-05-04 0 0  
## 3 S8 Denmark 1 129 2016-05-04 2016-05-04 0 0  
## 4 S8 Monti 1 130 2016-05-04 2016-05-04 0 0  
## 5 S8 Narrikup 1 131 2016-05-04 2016-05-04 0 0  
## 6 S8 Woogenellup 1 132 2016-05-04 2016-05-04 0 0  
## 7 S8 Denmark 2 133 2016-05-04 2016-05-04 0 0  
## 8 S8 Woogenellup 2 134 2016-05-04 2016-05-04 0 0  
## 9 S8 Narrikup 2 135 2016-05-04 2016-05-04 0 0  
## 10 S8 Leura 2 136 2016-05-04 2016-05-04 0 0  
## .. ... ... ... ... ... ... ... ...  
## Variables not shown: Sub2 (int), Sub3 (int), PlantPop (dbl), FINALPOP   
## (dbl), transf\_no (dbl)

summary(file.subset)

## SowTreat Cultivar Block Plot SowingDate   
## S8 :180 Antas :30 1:60 127 : 10 Min. :2016-05-04   
## S1 : 0 Denmark :30 2:60 128 : 10 1st Qu.:2016-05-04   
## S2 : 0 Leura :30 3:60 129 : 10 Median :2016-05-04   
## S3 : 0 Monti :30 130 : 10 Mean :2016-05-04   
## S4 : 0 Narrikup :30 131 : 10 3rd Qu.:2016-05-04   
## S5 : 0 Woogenellup:30 132 : 10 Max. :2016-05-04   
## (Other): 0 (Other):120   
## ReadingDate DAS Sub1 Sub2   
## Min. :2016-05-04 Min. : 0.0 Min. : 0.00 Min. : 0.00   
## 1st Qu.:2016-05-13 1st Qu.: 9.0 1st Qu.: 3.00 1st Qu.: 3.00   
## Median :2016-05-19 Median :15.0 Median :12.00 Median :12.00   
## Mean :2016-05-18 Mean :14.3 Mean :10.95 Mean :11.02   
## 3rd Qu.:2016-05-24 3rd Qu.:20.0 3rd Qu.:17.25 3rd Qu.:17.00   
## Max. :2016-05-29 Max. :25.0 Max. :28.00 Max. :28.00   
##   
## Sub3 PlantPop FINALPOP transf\_no   
## Min. : 0.00 Min. : 0.0 Min. :1833 Min. :1833   
## 1st Qu.: 2.00 1st Qu.: 333.3 1st Qu.:1900 1st Qu.:1900   
## Median :12.00 Median :1200.0 Median :2083 Median :2083   
## Mean :10.58 Mean :1084.8 Mean :2080 Mean :2080   
## 3rd Qu.:17.00 3rd Qu.:1766.7 3rd Qu.:2233 3rd Qu.:2233   
## Max. :28.00 Max. :2400.0 Max. :2400 Max. :2400   
##

my.anova <- aov(transf\_no ~ Cultivar + Block,   
 data = file.subset)  
summary(my.anova)

## Df Sum Sq Mean Sq F value Pr(>F)   
## Cultivar 5 1854942 370988 18.612 9.27e-15 \*\*\*  
## Block 2 53090 26545 1.332 0.267   
## Residuals 172 3428408 19933   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#Means separation   
(LSD.test(my.anova, c("Cultivar"), alpha= 0.05, p.adj="none") )

## $statistics  
## Mean CV MSerror LSD  
## 2079.63 6.788846 19932.61 71.95335  
##   
## $parameters  
## Df ntr t.value alpha test name.t  
## 172 6 1.973852 0.05 Fisher-LSD Cultivar  
##   
## $means  
## transf\_no std r LCL UCL Min Max  
## Antas 2088.890 166.85797 30 2038.011 2139.769 1900.00 2300.00  
## Denmark 2022.223 184.31704 30 1971.345 2073.102 1833.33 2266.67  
## Leura 2088.887 184.31538 30 2038.008 2139.765 1833.33 2233.33  
## Monti 1988.890 84.56908 30 1938.011 2039.769 1900.00 2100.00  
## Narrikup 2000.000 99.80633 30 1949.121 2050.879 1900.00 2133.33  
## Woogenellup 2288.890 84.56908 30 2238.011 2339.769 2200.00 2400.00  
##   
## $comparison  
## NULL  
## $groups  
## Cultivar means M  
## 1 Woogenellup 2288.890 a  
## 2 Antas 2088.890 b  
## 3 Leura 2088.887 b  
## 4 Denmark 2022.223 bc  
## 5 Narrikup 2000.000 c  
## 6 Monti 1988.890 c

#(LSD.test(my.anova, "Cultivar"))

REFERENCE

Saville, D. J. 2015. Multiple Comparison Procedures—Cutting the Gordian Knot. Agron. J. 107:730-735. doi:10.2134/agronj2012.0394