Anexo 1.

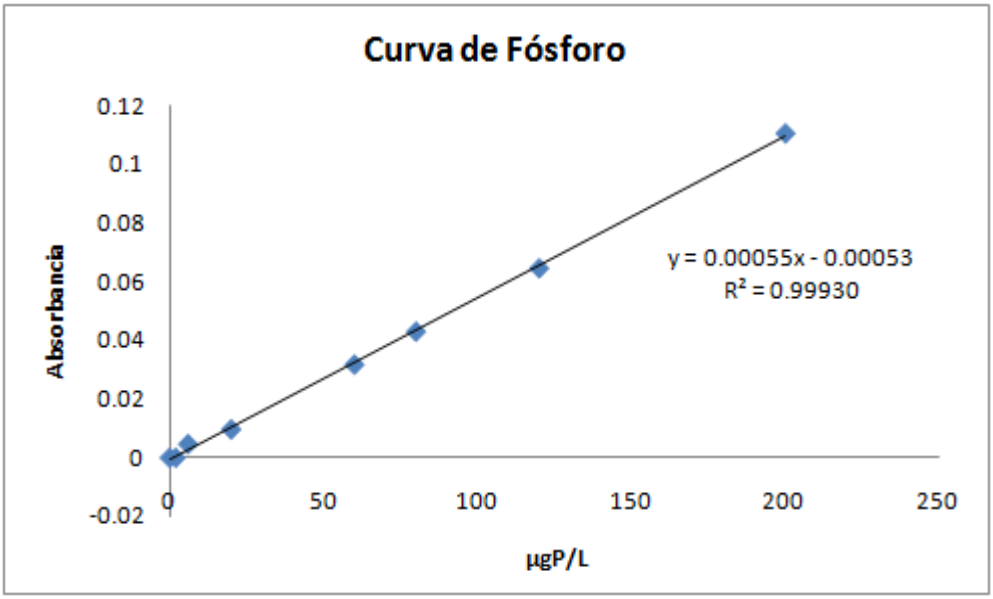
Datos físico-químicos de la laguna del Lirio (13 de marzo de 2019).

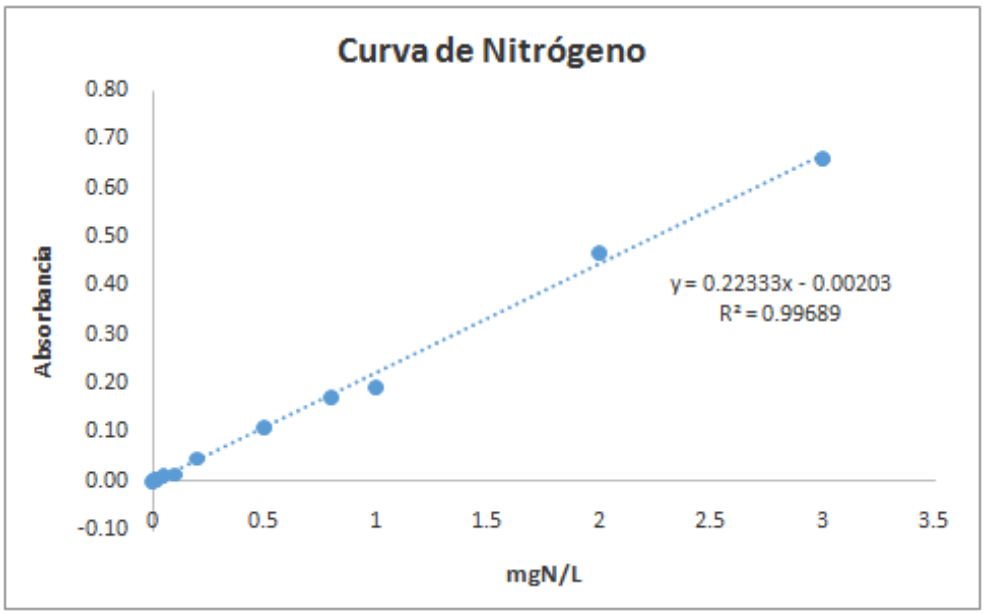
Profundidad (m)	pH	Temperatura (ºC)	Conductividad (µS/cm)	Salinidad (g/L)	Oxígeno disuelto (mg/L)	TDS (mg/L)
0	9,27	15,1	827	0,51	3,05	509
0,5	7,88	14,7	880	0,55	1,92	507
< 1	7,64	14,7	815	0,50	0,00	546

Datos físico-químicos de la laguna del Lirio (20 de marzo de 2019).

Profundidad	pH	Temperatura (ºC)	Conductividad (µS/cm)	Salinidad (g/L)	Oxígeno disuelto (mg/L)	TDS (mg/L)
0	8,13	-	970	0,62	5,58	800
< 1	7,36	-	980	0,62	3,10	806
Mezcla del bidón	8,16	14,5	987	0,62	9,69	800

Anexo 2. Curvas patrón para P y N.





Anexo 3.

Script y tablas de resultados para PT.

```
######
#####################################################################
> ###### 2way-ANOVA
#####################################################################
> ######
#####################################################################

> Datos$NUT <- as.factor(Datos$NUT)  # Convert "NUT" into factor
>
> Datos$M <- as.factor(Datos$M)     # Convert "M" into factor
>
>
> ##ANOVA de 2-vías para PT (raw data) con SS tipo III
> AnovaModel.1 <- aov(PT ~ NUT*M, data=Datos)
> Anova(AnovaModel.1, type=3)
Anova Table (Type III tests)

Response: PT
             Sum Sq Df F value    Pr(>F)
(Intercept)  81765  1 1007.95 7.028e-16 ***
NUT          52638  3  216.30 3.714e-13 ***
M            14193  1  174.96 4.958e-10 ***
NUT:M        78600  3  322.98 1.607e-14 ***
Residuals     1298 16
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
> with(Datos, (tapply(PT, list(NUT, M), mean, na.rm=TRUE))) # means
          NO        SI
C  165.0909 262.36364
N  109.6364 164.18182
NP 204.1818 220.90909
P  291.4545  91.63636
> with(Datos, (tapply(PT, list(NUT, M), sd, na.rm=TRUE))) # std.
deviations
           NO       SI
C   6.363636 7.215685
N  11.354542 6.363636
NP  9.620914 8.875633
P  11.354542 9.311860
> with(Datos, (tapply(PT, list(NUT,M), function(x) sum(!is.na(x))))) #
counts
   NO SI
C   3  3
N   3  3
NP  3  3
P   3  3
>
> ## test normalidad #####
>
> # with raw data
> with(Datos, shapiro.test(PT))

        Shapiro-Wilk normality test

data:  PT
W = 0.95447, p-value = 0.3376

>
> # with residuals
> shapiro.test(residuals(AnovaModel.1))

        Shapiro-Wilk normality test

data:  residuals(AnovaModel.1)
```

```
W = 0.95055, p-value = 0.2784

>
> # test homocedasticidad de Levene y de Barlett
> with(Datos, tapply(PT, list(NUT, M), var, na.rm=TRUE))
          NO       SI
C   40.49587 52.06612
N  128.92562 40.49587
NP  92.56198 78.77686
P  128.92562 86.71074
> leveneTest(PT ~ NUT*M, data=Datos, center="mean")
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  7  0.5203 0.8064
      16
> bartlett.test(PT ~ interaction(NUT, M), data=Datos)

        Bartlett test of homogeneity of variances

data:  PT by interaction(NUT, M)
Bartlett's K-squared = 1.2412, df = 7, p-value = 0.9899

>
>
> # medias para ver effect size
> model.tables(AnovaModel.1, "means", se=T)
Tables of means
Grand mean

188.6818

 NUT
NUT
     C      N     NP      P
213.73 136.91 212.55 191.55

 M
M
    NO     SI
192.59 184.77

 NUT:M
    M
NUT  NO     SI
  C  165.09 262.36
  N  109.64 164.18
  NP 204.18 220.91
  P  291.45  91.64

Standard errors for differences of means
          NUT     M NUT:M
        5.200 3.677 7.354
replic.     6    12     3
>
> ## Post hoc analisis ###
> # post-hoc con Tukey
> TukeyHSD(AnovaModel.1)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = PT ~ NUT * M, data = Datos)

$NUT
           diff       lwr         upr     p adj
N-C  -76.818182 -91.69547 -61.940894 0.0000000
NP-C  -1.181818 -16.05911  13.695470 0.9956893
P-C  -22.181818 -37.05911  -7.304530 0.0029832
NP-N  75.636364  60.75908  90.513652 0.0000000
P-N   54.636364  39.75908  69.513652 0.0000001
P-NP -21.000000 -35.87729  -6.122712 0.0047370
```

```
$M
           diff       lwr         upr     p adj
SI-NO -7.818182 -15.61297 -0.02339301 0.0493939

$`NUT:M`
                    diff         lwr         upr     p adj
N:NO-C:NO     -55.4545455  -80.914866  -29.994225 0.0000261
NP:NO-C:NO     39.0909091   13.630589   64.551230 0.0013949
P:NO-C:NO     126.3636364  100.903316  151.823957 0.0000000
C:SI-C:NO      97.2727273   71.812407  122.733048 0.0000000
N:SI-C:NO      -0.9090909  -26.369411   24.551230 1.0000000
NP:SI-C:NO     55.8181818   30.357861   81.278502 0.0000241
P:SI-C:NO     -73.4545455  -98.914866  -47.994225 0.0000006
NP:NO-N:NO     94.5454545   69.085134  120.005775 0.0000000
P:NO-N:NO     181.8181818  156.357861  207.278502 0.0000000
C:SI-N:NO     152.7272727  127.266952  178.187593 0.0000000
N:SI-N:NO      54.5454545   29.085134   80.005775 0.0000321
NP:SI-N:NO    111.2727273   85.812407  136.733048 0.0000000
P:SI-N:NO     -18.0000000  -43.460320    7.460320 0.2836343
P:NO-NP:NO     87.2727273   61.812407  112.733048 0.0000001
C:SI-NP:NO     58.1818182   32.721498   83.642139 0.0000142
N:SI-NP:NO    -40.0000000  -65.460320  -14.539680 0.0011026
NP:SI-NP:NO    16.7272727   -8.733048   42.187593 0.3624869
P:SI-NP:NO   -112.5454545 -138.005775  -87.085134 0.0000000
C:SI-P:NO     -29.0909091  -54.551230   -3.630589 0.0194820
N:SI-P:NO    -127.2727273 -152.733048 -101.812407 0.0000000
NP:SI-P:NO    -70.5454545  -96.005775  -45.085134 0.0000011
P:SI-P:NO    -199.8181818 -225.278502 -174.357861 0.0000000
N:SI-C:SI     -98.1818182 -123.642139  -72.721498 0.0000000
NP:SI-C:SI    -41.4545455  -66.914866  -15.994225 0.0007591
P:SI-C:SI    -170.7272727 -196.187593 -145.266952 0.0000000
NP:SI-N:SI     56.7272727   31.266952   82.187593 0.0000196
P:SI-N:SI     -72.5454545  -98.005775  -47.085134 0.0000008
P:SI-NP:SI   -129.2727273 -154.733048 -103.812407 0.0000000

>
> # post-hoc con LSD
> pairwise.t.test(Datos$PT, Datos$NUT:Datos$M, p.adj= "none")

        Pairwise comparisons using t tests with pooled SD

data:  Datos$PT and Datos$NUT:Datos$M

      C:NO    C:SI    N:NO    N:SI    NP:NO   NP:SI   P:NO
C:SI  5.0e-10 -       -       -       -       -       -
N:NO  1.2e-06 5.3e-13 -       -       -       -       -
N:SI  0.9032  4.3e-10 1.5e-06 -       -       -       -
NP:NO 7.0e-05 6.4e-07 7.5e-10 5.5e-05 -       -       -
NP:SI 1.1e-06 3.7e-05 6.7e-11 8.9e-07 0.0370  -       -
P:NO  9.8e-12 0.0011  3.6e-14 8.8e-12 2.4e-09 4.9e-08 -
P:SI  2.8e-08 9.5e-14 0.0263  3.3e-08 5.7e-11 6.9e-12 8.1e-15

P value adjustment method: none
```

Script y tablas de resultados para PD.

```
######            ###################################################################
> ###### 2way-ANOVA ###################################################################
> ######            ###################################################################
>
> Datos$NUT <- as.factor(Datos$NUT)  # Convert "NUT" into factor
>
> Datos$M <- as.factor(Datos$M)     # Convert "M" into factor
>
>
> ##ANOVA de 2-vías para PD (raw data) con SS tipo III
> AnovaModel.1 <- aov(PD ~ NUT*M, data=Datos)
> Anova(AnovaModel.1, type=3)
Anova Table (Type III tests)

Response: PD
             Sum Sq Df F value    Pr(>F)
(Intercept)  35663  1 344.871 2.992e-12 ***
NUT          35309  3 113.816 5.272e-11 ***
M             1217  1  11.770  0.003431 **
NUT:M         9005  3  29.026 1.045e-06 ***
Residuals     1655 16
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
> with(Datos, (tapply(PD, list(NUT, M), mean, na.rm=TRUE))) # means
          NO        SI
C  109.03030 137.51515
N   44.18182  64.48485
NP 111.75758  88.12121
P  196.90909 128.42424
> with(Datos, (tapply(PD, list(NUT, M), sd, na.rm=TRUE))) # std. deviations
          NO        SI
C  10.013765 12.607663
N   3.962635  5.479740
NP 13.916318  8.735476
P  10.909091 11.547005
> with(Datos, (tapply(PD, list(NUT,M), function(x) sum(!is.na(x))))) # counts
   NO SI
C   3  3
N   3  3
NP  3  3
P   3  3
>
> ## test normalidad #####
>
> # with raw data
> with(Datos, shapiro.test(PD))

        Shapiro-Wilk normality test

data:  PD
W = 0.95671, p-value = 0.376

>
> # with residuals
> shapiro.test(residuals(AnovaModel.1))

        Shapiro-Wilk normality test

data:  residuals(AnovaModel.1)
W = 0.95663, p-value = 0.3746

>
> # test homocedasticidad de Levene y de Barlett
> with(Datos, tapply(PD, list(NUT, M), var, na.rm=TRUE))
          NO        SI
```

```
C  100.27548 158.95317
N   15.70248  30.02755
NP 193.66391  76.30854
P  119.00826 133.33333
> leveneTest(PD ~ NUT*M, data=Datos, center="mean")
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  7  0.9644 0.4882
      16
> bartlett.test(PD ~ interaction(NUT, M), data=Datos)

        Bartlett test of homogeneity of variances

data:  PD by interaction(NUT, M)
Bartlett's K-squared = 3.3754, df = 7, p-value = 0.8482

>
>
> # medias para ver effect size
> model.tables(AnovaModel.1, "means", se=T)
Tables of means
Grand mean

110.053

 NUT
NUT
     C      N     NP      P
123.27  54.33  99.94 162.67

 M
M
    NO     SI
115.47 104.64

 NUT:M
    M
NUT  NO     SI
  C  109.03 137.52
  N   44.18  64.48
  NP 111.76  88.12
  P  196.91 128.42

Standard errors for differences of means
         NUT     M NUT:M
       5.871 4.151 8.303
replic.     6    12     3
>
> ## Post hoc analisis ###
> # post-hoc con Tukey
> TukeyHSD(AnovaModel.1)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = PD ~ NUT * M, data = Datos)

$NUT
          diff       lwr        upr     p adj
N-C  -68.93939 -85.73670 -52.142089 0.0000000
NP-C -23.33333 -40.13064  -6.536029 0.0053985
P-C   39.39394  22.59663  56.191244 0.0000271
NP-N  45.60606  28.80876  62.403365 0.0000044
P-N  108.33333  91.53603 125.130638 0.0000000
P-NP  62.72727  45.92997  79.524577 0.0000001

$M
           diff       lwr       upr     p adj
SI-NO -10.83333 -19.63409 -2.032573 0.0189708
```

```
$`NUT:M`
                  diff          lwr         upr     p adj
N:NO-C:NO    -64.848485  -93.5946355  -36.102334 0.0000168
NP:NO-C:NO     2.727273  -26.0188779   31.473423 0.9999691
P:NO-C:NO     87.878788   59.1326372  116.624939 0.0000003
C:SI-C:NO     28.484848   -0.2613022   57.230999 0.0530292
N:SI-C:NO    -44.545455  -73.2916052  -15.799304 0.0012698
NP:SI-C:NO   -20.909091  -49.6552416    7.837060 0.2551905
P:SI-C:NO     19.393939   -9.3522113   48.140090 0.3331682
NP:NO-N:NO    67.575758   38.8296069   96.321908 0.0000099
P:NO-N:NO    152.727273  123.9811221  181.473423 0.0000000
C:SI-N:NO     93.333333   64.5871827  122.079484 0.0000001
N:SI-N:NO     20.303030   -8.4431204   49.049181 0.2846432
NP:SI-N:NO    43.939394   15.1932433   72.685545 0.0014593
P:SI-N:NO     84.242424   55.4962736  112.988575 0.0000005
P:NO-NP:NO    85.151515   56.4053645  113.897666 0.0000004
C:SI-NP:NO    25.757576   -2.9885749   54.503726 0.0966199
N:SI-NP:NO   -47.272727  -76.0188779  -18.526577 0.0006830
NP:SI-NP:NO  -23.636364  -52.3825143    5.109787 0.1505373
P:SI-NP:NO    16.666667  -12.0794840   45.412817 0.5064786
C:SI-P:NO    -59.393939  -88.1400901  -30.647789 0.0000500
N:SI-P:NO   -132.424242 -161.1703931 -103.678092 0.0000000
NP:SI-P:NO  -108.787879 -137.5340295  -80.041728 0.0000000
P:SI-P:NO    -68.484848  -97.2309992  -39.738698 0.0000083
N:SI-C:SI    -73.030303 -101.7764537  -44.284152 0.0000036
NP:SI-C:SI   -49.393939  -78.1400901  -20.647789 0.0004248
P:SI-C:SI     -9.090909  -37.8370598   19.655242 0.9488459
NP:SI-N:SI    23.636364   -5.1097870   52.382514 0.1505373
P:SI-N:SI     63.939394   35.1932433   92.685545 0.0000201
P:SI-NP:SI    40.303030   11.5568796   69.049181 0.0033908

>
> # post-hoc con LSD
> pairwise.t.test(Datos$PD, Datos$NUT:Datos$M, p.adj= "none")

        Pairwise comparisons using t tests with pooled SD

data:  Datos$PD and Datos$NUT:Datos$M

      C:NO    C:SI    N:NO    N:SI    NP:NO   NP:SI   P:NO
C:SI  0.00343 -       -       -       -       -       -
N:NO  7.6e-07 5.3e-09 -       -       -       -       -
N:SI  6.3e-05 1.6e-07 0.02642 -       -       -       -
NP:NO 0.74682 0.00685 4.4e-07 3.3e-05 -       -       -
NP:SI 0.02282 2.0e-05 7.3e-05 0.01166 0.01166 -       -
P:NO  1.2e-08 2.3e-06 3.5e-12 3.0e-11 1.9e-08 5.7e-10 -
P:SI  0.03285 0.28977 2.2e-08 9.1e-07 0.06192 0.00018 3.7e-07

P value adjustment method: none

>
```

Anexo 4.

Script y tablas de resultados para NT

```
> ###### 2way-ANOVA
#################################################################
##

> ######
#################################################################
>
>
> Datos$NUT <- as.factor(Datos$NUT)  # Convert "NUT" into factor
>
> Datos$M <- as.factor(Datos$M)     # Convert "M" into factor
>
>
> ##ANOVA de 2-vías para NT (raw data) con SS tipo III
> AnovaModel.1 <- aov(NT ~ NUT*M, data=Datos)
> Anova(AnovaModel.1, type=3)
Anova Table (Type III tests)

Response: NT
             Sum Sq Df  F value    Pr(>F)
(Intercept) 18.5635  1 860.2759 2.446e-15 ***
NUT          6.0672  3  93.7231 2.301e-10 ***
M            0.0001  1   0.0033    0.9551
NUT:M        0.9270  3  14.3191 8.554e-05 ***
Residuals    0.3453 16
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
> with(Datos, (tapply(NT, list(NUT, M), mean, na.rm=TRUE))) # means
         NO       SI
C  2.487535 2.494402
N  3.873712 3.160173
NP 3.622929 3.024332
P  2.213763 2.430213
> with(Datos, (tapply(NT, list(NUT, M), sd, na.rm=TRUE))) # std.
deviations
           NO        SI
C  0.1438256 0.1524590
N  0.1241057 0.1498246
NP 0.1575056 0.1523493
P  0.1769535 0.1073231
> with(Datos, (tapply(NT, list(NUT,M), function(x) sum(!is.na(x))))) #
counts
   NO SI
C   3  3
N   3  3
NP  3  3
P   3  3
> ## test normalidad #####
>
> # with raw data
> with(Datos, shapiro.test(NT))

        Shapiro-Wilk normality test

data:  NT
W = 0.9223, p-value = 0.06567

> # with residuals
> shapiro.test(residuals(AnovaModel.1))

        Shapiro-Wilk normality test

data:  residuals(AnovaModel.1)
```

```
W = 0.90418, p-value = 0.02642; es menor que 0,05 por lo que hay que
hacer transformación log
>
> # test homocedasticidad de Levene y de Barlett
> with(Datos, tapply(NT, list(NUT, M), var, na.rm=TRUE))
           NO         SI
C  0.02068579 0.02324374
N  0.01540224 0.02244742
NP 0.02480803 0.02321031
P  0.03131253 0.01151825
> leveneTest(NT ~ NUT*M, data=Datos, center="mean")
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  7  0.1118 0.9966
      16
> bartlett.test(NT ~ interaction(NUT, M), data=Datos)

        Bartlett test of homogeneity of variances

data:  NT by interaction(NUT, M)
Bartlett's K-squared = 0.51993, df = 7, p-value = 0.9994

>
>
> # medias para ver effect size
> model.tables(AnovaModel.1, "means", se=T)
Tables of means
Grand mean

2.913383

 NUT
NUT
    C     N    NP     P
2.491 3.517 3.324 2.322

 M
M
    NO     SI
3.0495 2.7773

 NUT:M
    M
NUT  NO    SI
  C  2.488 2.494
  N  3.874 3.160
  NP 3.623 3.024
  P  2.214 2.430

Standard errors for differences of means
            NUT       M   NUT:M
        0.08481 0.05997 0.11994
replic.       6      12       3
> #### log-transformacion var. resp ####
> Datos$logNT <- with(Datos, log(NT))
> View(Datos)
> #ANOVA de 2 vias para logNT con SS tipo III
> AnovaModel.2 <- aov(logNT ~ NUT*M, data=Datos)
> Anova(AnovaModel.2, type=3)
Anova Table (Type III tests)

Response: logNT
             Sum Sq Df  F value    Pr(>F)
(Intercept) 2.48513  1 857.6191 2.506e-15 ***
NUT         0.68708  3  79.0378 8.268e-10 ***
M           0.00001  1   0.0036 0.9527483
NUT:M       0.09394  3  10.8067 0.0003987 ***
Residuals   0.04636 16
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
>
> with(Datos, (tapply(logNT, list(NUT, M), mean, na.rm=TRUE))) # means
          NO        SI
C  0.9101515 0.9127970
N  1.3538668 1.1498865
NP 1.2866552 1.1058450
P  0.7925880 0.8873173
> with(Datos, (tapply(logNT, list(NUT, M), sd, na.rm=TRUE))) # std.
deviations
           NO         SI
C  0.05884666 0.06137056
N  0.03234546 0.04698587
NP 0.04334586 0.05034786
P  0.07925787 0.04475359
> with(Datos, (tapply(logNT, list(NUT,M), function(x)
sum(!is.na(x))))) # counts
   NO SI
C   3  3
N   3  3
NP  3  3
P   3  3
>
> # test normalidad ####
>
> # with raw log-data
> with(Datos, shapiro.test(logNT))

        Shapiro-Wilk normality test

data:  logNT
W = 0.93913, p-value = 0.156

> # with residuals
> shapiro.test(residuals(AnovaModel.2))

        Shapiro-Wilk normality test

data:  residuals(AnovaModel.2)
W = 0.95926, p-value = 0.4237

> # test homocedasticidad de Levene y de Barlett
> with(Datos, tapply(logNT, list(NUT, M), var, na.rm=TRUE))
            NO          SI
C  0.003462930 0.003766346
N  0.001046229 0.002207672
NP 0.001878864 0.002534907
P  0.006281809 0.002002884
> leveneTest(logNT ~ NUT*M, data=Datos, center="mean")
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  7  0.4755 0.8385
      16
> bartlett.test(logNT ~ interaction(NUT, M), data=Datos)

        Bartlett test of homogeneity of variances

data:  logNT by interaction(NUT, M)
Bartlett's K-squared = 1.706, df = 7, p-value = 0.9743

> # medias para ver effect size
> model.tables(AnovaModel.2, "means", se=T)
Tables of means
Grand mean

1.049888

 NUT
NUT
     C      N     NP      P
0.9115 1.2519 1.1963 0.8400
```

```
 M
M
    NO     SI
1.0858 1.0140

 NUT:M
    M
NUT  NO     SI
  C  0.9102 0.9128
  N  1.3539 1.1499
  NP 1.2867 1.1058
  P  0.7926 0.8873

Standard errors for differences of means
           NUT       M   NUT:M
        0.03108 0.02198 0.04395
replic.       6      12       3
>
> ## Post hoc analisis ###
> # post-hoc con Tukey
> TukeyHSD(AnovaModel.2)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = logNT ~ NUT * M, data = Datos)

$NUT
             diff        lwr         upr     p adj
N-C   0.34040238  0.2514849  0.42931990 0.0000000
NP-C  0.28477584  0.1958583  0.37369336 0.0000005
P-C  -0.07152161 -0.1604391  0.01739591 0.1392699
NP-N -0.05562654 -0.1445441  0.03329097 0.3136731
P-N  -0.41192399 -0.5008415 -0.32300647 0.0000000
P-NP -0.35629745 -0.4452150 -0.26737993 0.0000000

$M
              diff        lwr         upr     p adj
SI-NO -0.07185392 -0.1184413 -0.02526658 0.0048178

$`NUT:M`
                     diff         lwr         upr     p adj
N:NO-C:NO     0.443715330  0.29154590  0.59588476 0.0000006
NP:NO-C:NO    0.376503752  0.22433432  0.52867318 0.0000051
P:NO-C:NO    -0.117563492 -0.26973292  0.03460594 0.1998063
C:SI-C:NO     0.002645565 -0.14952387  0.15481500 1.0000000
N:SI-C:NO     0.239735003  0.08756557  0.39190444 0.0010714
NP:SI-C:NO    0.195693494  0.04352406  0.34786293 0.0074094
P:SI-C:NO    -0.022834156 -0.17500359  0.12933528 0.9993495
NP:NO-N:NO   -0.067211579 -0.21938101  0.08495785 0.7820167
P:NO-N:NO    -0.561278822 -0.71344826 -0.40910939 0.0000000
C:SI-N:NO    -0.441069765 -0.59323920 -0.28890033 0.0000006
N:SI-N:NO    -0.203980327 -0.35614976 -0.05181089 0.0051304
NP:SI-N:NO   -0.248021836 -0.40019127 -0.09585240 0.0007508
P:SI-N:NO    -0.466549486 -0.61871892 -0.31438005 0.0000003
P:NO-NP:NO   -0.494067243 -0.64623668 -0.34189781 0.0000001
C:SI-NP:NO   -0.373858186 -0.52602762 -0.22168875 0.0000056
N:SI-NP:NO   -0.136768749 -0.28893818  0.01540068 0.0949901
NP:SI-NP:NO  -0.180810258 -0.33297969 -0.02864082 0.0143380
P:SI-NP:NO   -0.399337907 -0.55150734 -0.24716847 0.0000023
C:SI-P:NO     0.120209057 -0.03196038  0.27237849 0.1812393
N:SI-P:NO     0.357298495  0.20512906  0.50946793 0.0000101
NP:SI-P:NO    0.313256986  0.16108755  0.46542642 0.0000523
P:SI-P:NO     0.094729336 -0.05744010  0.24689877 0.4238933
N:SI-C:SI     0.237089438  0.08492000  0.38925887 0.0012011
NP:SI-C:SI    0.193047929  0.04087850  0.34521736 0.0083327
P:SI-C:SI    -0.025479721 -0.17764915  0.12668971 0.9986875
NP:SI-N:SI   -0.044041509 -0.19621094  0.10812792 0.9674596
P:SI-N:SI    -0.262569159 -0.41473859 -0.11039973 0.0004056
P:SI-NP:SI   -0.218527650 -0.37069708 -0.06635822 0.0026990
```

```
>
> # post-hoc con LSD
> pairwise.t.test(Datos$logNT, Datos$NUT:Datos$M, p.adj= "none")

        Pairwise comparisons using t tests with pooled SD

data:  Datos$logNT and Datos$NUT:Datos$M

      C:NO    C:SI    N:NO    N:SI    NP:NO   NP:SI   P:NO
C:SI  0.95275 -       -       -       -       -       -
N:NO  2.4e-08 2.6e-08 -       -       -       -       -
N:SI  5.3e-05 6.0e-05 0.00027 -       -       -       -
NP:NO 2.3e-07 2.5e-07 0.14574 0.00671 -       -       -
NP:SI 0.00040 0.00045 3.7e-05 0.33124 0.00081 -       -
P:NO  0.01661 0.01468 8.3e-10 4.5e-07 5.3e-09 2.4e-06 -
P:SI  0.61051 0.57018 1.2e-08 1.9e-05 1.0e-07 0.00014 0.04672

P value adjustment method: none
```

Script y tablas de resultados para ND.

```
######            ###################################################################
> ###### 2way-ANOVA ###################################################################
> ######            ###################################################################

> Datos$NUT <- as.factor(Datos$NUT)  # Convert "NUT" into factor
>
> Datos$M <- as.factor(Datos$M)     # Convert "M" into factor
>
>
> ##ANOVA de 2-vías para ND (raw data) con SS tipo III
> AnovaModel.1 <- aov(ND ~ NUT*M, data=Datos)
> Anova(AnovaModel.1, type=3)
Anova Table (Type III tests)

Response: ND
             Sum Sq Df  F value    Pr(>F)
(Intercept) 7.4688  1 334.0644 3.818e-12 ***
NUT         8.6716  3 129.2883 1.990e-11 ***
M           0.0112  1   0.5029    0.4884
NUT:M       4.0892  3  60.9679 5.640e-09 ***
Residuals   0.3577 16
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
> with(Datos, (tapply(ND, list(NUT, M), mean, na.rm=TRUE))) # means
         NO       SI
C  1.577847 1.664428
N  3.522615 1.785341
NP 3.266159 2.792954
P  1.852366 2.287655
> with(Datos, (tapply(ND, list(NUT, M), sd, na.rm=TRUE))) # std. deviations
          NO         SI
C  0.1516236 0.09855609
N  0.1850175 0.18714354
NP 0.1168937 0.12950931
P  0.1518199 0.15302247
> with(Datos, (tapply(ND, list(NUT,M), function(x) sum(!is.na(x))))) # counts
   NO SI
C   3  3
N   3  3
NP  3  3
P   3  3
>
> ## test normalidad #####
>
> # with raw data
> with(Datos, shapiro.test(ND))

        Shapiro-Wilk normality test

data:  ND
W = 0.88925, p-value = 0.01283

>
> # with residuals
> shapiro.test(residuals(AnovaModel.1))

        Shapiro-Wilk normality test

data:  residuals(AnovaModel.1)
W = 0.92885, p-value = 0.09189

>


> # test homocedasticidad de Levene y de Barlett
```

```
> with(Datos, tapply(ND, list(NUT, M), var, na.rm=TRUE))
           NO          SI
C  0.02298971 0.009713302
N  0.03423147 0.035022706
NP 0.01366414 0.016772661
P  0.02304927 0.023415878
> leveneTest(ND ~ NUT*M, data=Datos, center="mean")
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  7  0.3621 0.9112
      16
> bartlett.test(ND ~ interaction(NUT, M), data=Datos)

        Bartlett test of homogeneity of variances

data:  ND by interaction(NUT, M)
Bartlett's K-squared = 1.0678, df = 7, p-value = 0.9937

>
>
> # medias para ver effect size
> model.tables(AnovaModel.1, "means", se=T)
Tables of means
Grand mean

2.343671

 NUT
NUT
     C      N     NP      P
1.6211 2.6540 3.0296 2.0700

 M
M
    NO     SI
2.5547 2.1326

 NUT:M
    M
NUT  NO    SI
  C  1.578 1.664
  N  3.523 1.785
  NP 3.266 2.793
  P  1.852 2.288

Standard errors for differences of means
           NUT       M   NUT:M
        0.08633 0.06104 0.12209
replic.       6      12       3
>
> ## Post hoc analisis ###
> # post-hoc con Tukey
> TukeyHSD(AnovaModel.1)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = ND ~ NUT * M, data = Datos)

$NUT
           diff        lwr        upr     p adj
N-C   1.0328407  0.7858556  1.2798259 0.0000000
NP-C  1.4084192  1.1614340  1.6554043 0.0000000
P-C   0.4488730  0.2018878  0.6958581 0.0004598
NP-N  0.3755784  0.1285933  0.6225636 0.0025111
P-N  -0.5839678 -0.8309529 -0.3369826 0.0000246
P-NP -0.9595462 -1.2065313 -0.7125611 0.0000000


$M
```

```
            diff        lwr        upr   p adj
SI-NO -0.4221526 -0.5515577 -0.2927475 3.5e-06

$`NUT:M`
                    diff         lwr         upr     p adj
N:NO-C:NO     1.94476788  1.52208865  2.36744710 0.0000000
NP:NO-C:NO    1.68831169  1.26563246  2.11099092 0.0000000
P:NO-C:NO     0.27451858 -0.14816064  0.69719781 0.3754269
C:SI-C:NO     0.08658009 -0.33609914  0.50925932 0.9954225
N:SI-C:NO     0.20749366 -0.21518557  0.63017288 0.6877714
NP:SI-C:NO    1.21510673  0.79242750  1.63778596 0.0000007
P:SI-C:NO     0.70980743  0.28712821  1.13248666 0.0005454
NP:NO-N:NO   -0.25645619 -0.67913542  0.16622304 0.4536759
P:NO-N:NO    -1.67024929 -2.09292852 -1.24757006 0.0000000
C:SI-N:NO    -1.85818779 -2.28086702 -1.43550856 0.0000000
N:SI-N:NO    -1.73727422 -2.15995345 -1.31459499 0.0000000
NP:SI-N:NO   -0.72966114 -1.15234037 -0.30698192 0.0004036
P:SI-N:NO    -1.23496044 -1.65763967 -0.81228121 0.0000005
P:NO-NP:NO   -1.41379310 -1.83647233 -0.99111388 0.0000001
C:SI-NP:NO   -1.60173160 -2.02441083 -1.17905237 0.0000000
N:SI-NP:NO   -1.48081803 -1.90349726 -1.05813880 0.0000000
NP:SI-NP:NO  -0.47320496 -0.89588418 -0.05052573 0.0227331
P:SI-NP:NO   -0.97850425 -1.40118348 -0.55582503 0.0000121
C:SI-P:NO    -0.18793850 -0.61061773  0.23474073 0.7766899
N:SI-P:NO    -0.06702493 -0.48970416  0.35565430 0.9990722
NP:SI-P:NO    0.94058815  0.51790892  1.36326738 0.0000199
P:SI-P:NO     0.43528885  0.01260962  0.85796808 0.0411685
N:SI-C:SI     0.12091357 -0.30176566  0.54359280 0.9693966
NP:SI-C:SI    1.12852665  0.70584742  1.55120587 0.0000018
P:SI-C:SI     0.62322735  0.20054812  1.04590658 0.0020890
NP:SI-N:SI    1.00761308  0.58493385  1.43029231 0.0000083
P:SI-N:SI     0.50231378  0.07963455  0.92499301 0.0143199
P:SI-NP:SI   -0.50529930 -0.92797853 -0.08262007 0.0136545

>
> # post-hoc con LSD
> pairwise.t.test(Datos$ND, Datos$NUT:Datos$M, p.adj= "none")

        Pairwise comparisons using t tests with pooled SD

data:  Datos$ND and Datos$NUT:Datos$M

      C:NO    C:SI    N:NO    N:SI    NP:NO   NP:SI   P:NO
C:SI  0.48842 -       -       -       -       -       -
N:NO  3.1e-11 6.1e-11 -       -       -       -       -
N:SI  0.10857 0.33672 1.7e-10 -       -       -       -
NP:NO 2.6e-10 5.6e-10 0.05188 1.8e-09 -       -       -
NP:SI 2.9e-08 8.1e-08 1.9e-05 3.7e-07 0.00134 -       -
P:NO  0.03898 0.14325 3.0e-10 0.59059 3.4e-09 9.0e-07 -
P:SI  2.6e-05 0.00011 2.3e-08 0.00081 5.4e-07 0.00077 0.00258

P value adjustment method: none
```

Anexo 5. Datos obtenidos de la medición de absorbancia para obtener la concentración P. Se incluyen desviaciones típicas y covarianza.

Tratamientos	Nº Muestra	Abs	[ppb]	Media [ppb]	DT	CV
CONTROL DISUELTO	1PD	0.0060	118.7			
	2PD	0.0055	109.6			
	3PD	0.0049	98.7	109.0	10.01	9.18
CONTROL TOTAL	4PT	0.0087	167.8			
	5PT	0.0088	169.6			
	6PT	0.0082	157.8	165.1	6.36	3.85
N DISUELTO	7ND	0.0017	39.6			
	8ND	0.0021	46.9			
	9ND	0.0020	46.0	44.2	3.96	8.97
N TOTAL	10NT	0.0060	118.7			
	11NT	0.0048	96.9			
	12NT	0.0057	113.3	109.6	11.35	10.36
P DISUELTO	13 PD	0.0103	196.9			
	14PD	0.0097	186.0			
	15 PD	0.0109	207.8	196.9	10.91	5.54
P TOTAL	16PT	0.0153	287.8			
	17PT	0.0162	304.2			
	18PT	0.0150	282.4	291.5	11.35	3.90
NP DISUELTO	19NPD	0.0059	116.9			
	20NPD	0.0048	96.0			
	21NPD	0.0062	122.4	111.8	13.92	12.45
NP TOTAL	22NPT	0.0113	215.1			
	23NPT	0.0105	200.5			
	24NPT	0.0103	196.9	204.2	9.62	4.71
CONTROL D M	25PD	0.0069	134.2			
	26PD	0.0065	126.9			
	27PD	0.0078	151.5	137.5	12.61	9.17
CONTROL T M	28PT	0.0144	270.5			
	29PT	0.0136	256.9			
	30PT	0.0138	259.6	262.4	7.22	2.75
N DISUELTO M	31ND	0.0027	58.7			
	32ND	0.0031	65.1			
	33ND	0.0033	69.6	64.5	5.48	8.50
N TOTAL M	34NT	0.0084	161.5			
	35NT	0.0083	159.6			
	36NT	0.0089	171.5	164.2	6.36	3.88
P DISUELTO M	37 PD	0.0058	115.1			
	38PD	0.0069	135.1			
	39 PD	0.0069	135.1	128.4	11.55	8.99
P TOTAL M	40PT	0.0039	81.1			
	41PT	0.0049	98.7			
	42PT	0.0047	95.1	91.6	9.31	10.16
NP DISUELTO M	43NPD	0.0044	89.6			
	44NPD	0.0048	96.0			
	45NPD	0.0038	78.7	88.1	8.74	9.91
NP TOTAL M	46NPT	0.0118	223.3			
	47NPT	0.0120	228.4			
	48NPT	0.0111	211.1	220.9	8.88	4.02

Anexo 6. Datos obtenidos de la medición de absorbancia para obtener la concentración N. Se incluyen desviaciones típicas y covarianza.

Tratamientos	Nº Muestra	Abs 220	Abs 275	[ppb]	Media [ppb]	DT	CV
CONTROL DISUELTO	1PD	0.0437	0.0037	1.72			
	2PD	0.0492	0.0098	1.42			
	3PD	0.0470	0.0066	1.60	1.58	0.15	9.61
CONTROL TOTAL	4PT	0.0671	0.0058	2.58			
	5PT	0.0662	0.0082	2.32			
	6PT	0.0707	0.0077	2.57	2.49	0.14	5.78
N DISUELTO	7ND	0.0793	0.0022	3.44			
	8ND	0.0779	0.0021	3.39			
	9ND	0.0852	0.0019	3.73	3.52	0.19	5.25
N TOTAL	10NT	0.0909	0.0024	3.95			
	11NT	0.0987	0.0087	3.73			
	12NT	0.0913	0.0026	3.95	3.87	0.12	3.20
P DISUELTO	13PD	0.0435	0.0039	1.69			
	14PD	0.0527	0.0052	1.99			
	15 PD	0.0522	0.0061	1.88	1.85	0.15	8.20
P TOTAL	16PT	0.0551	0.0056	2.06			
	17PT	0.0605	0.0069	2.18			
	18PT	0.0673	0.0078	2.40	2.21	0.18	7.99
NP DISUELTO	19NPD	0.0864	0.0067	3.36			
	20NPD	0.0766	0.0024	3.30			
	21NPD	0.0752	0.0036	3.13	3.27	0.12	3.58
NP TOTAL	22NPT	0.0906	0.0040	3.79			
	23NPT	0.0914	0.0079	3.48			
	24NPT	0.0881	0.0048	3.61	3.62	0.16	4.35
CONTROL D M	25PD	0.0681	0.0165	1.66			
	26PD	0.0664	0.0145	1.76			
	27PD	0.0680	0.0175	1.57	1.66	0.10	5.92
CONTROL T M	28PT	0.0962	0.0230	2.34			
	29PT	0.0834	0.0132	2.64			
	30PT	0.0771	0.0116	2.50	2.49	0.15	6.11
N DISUELTO M	31ND	0.0500	0.0080	1.61			
	32ND	0.0581	0.0079	1.98			
	33ND	0.0513	0.0070	1.76	1.79	0.19	10.48
N TOTAL M	34NT	0.0905	0.0091	3.33			
	35NT	0.0843	0.0092	3.04			
	36NT	0.0849	0.0087	3.12	3.16	0.15	4.74
P DISUELTO M	37PD	0.0593	0.0036	2.42			
	38PD	0.0554	0.0050	2.12			
	39PD	0.0573	0.0038	2.32	2.29	0.15	6.69
P TOTAL M	40PT	0.0655	0.0059	2.49			
	41PT	0.0618	0.0041	2.49			
	42PT	0.0597	0.0051	2.31	2.43	0.11	4.42
NP DISUELTO M	43NPD	0.0725	0.0045	2.93			
	44NPD	0.0718	0.0060	2.77			
	45NPD	0.0642	0.0032	2.68	2.79	0.13	4.64
NP TOTAL M	46NPT	0.0858	0.0102	3.02			
	47NPT	0.0984	0.0147	3.18			
	48NPT	0.0994	0.0186	2.88	3.02	0.15	5.04