HW7

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April 21, 2018

data wrangling

```
library("tidyverse")
```

```
## -- Attaching packages ----------------------------------------------------------------------- tidyve
## v ggplot2 2.2.1     v purrr   0.2.4
## v tibble  1.4.1     v dplyr   0.7.4
## v tidyr   0.7.2     v stringr 1.2.0
## v readr   1.1.1     v forcats 0.2.0
## -- Conflicts -------------------------------------------------------------------------- tidyverse_co
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library("dplyr")
require(corrplot)
```

```
## Loading required package: corrplot
## Warning: package 'corrplot' was built under R version 3.4.4
## corrplot 0.84 loaded
```

```
require(car)
```

```
## Loading required package: car
## Warning: package 'car' was built under R version 3.4.4
## Loading required package: carData
## Warning: package 'carData' was built under R version 3.4.4
##
## Attaching package: 'car'
## The following object is masked from 'package:dplyr':
##
##     recode
## The following object is masked from 'package:purrr':
##
##     some
```

```
require(broom)
```

```
## Loading required package: broom
```

```
wq <- read_csv("BayDeltaWQ.csv", col_names = TRUE, na = c("NA", "n/p", "n/a"), guess_max = 30000)
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   X1 = col_integer(),
##   SampleDate = col_date(format = ""),
##   StationCode = col_character(),
##   Depth = col_integer(),
##   `Tide Stage` = col_integer(),
##   `Tide Time` = col_character(),
##   `Weather Observations` = col_character(),
##   `Wind Direction` = col_integer(),
##   `Wind Velocity` = col_integer(),
##   VarType = col_character(),
##   Alachlor = col_character(),
##   Aldrin = col_character(),
##   `Arsenic (Dissolved)` = col_integer(),
##   `Arsenic (Total)` = col_integer(),
##   Atrazine = col_character(),
##   `BHC-alpha` = col_character(),
##   `BHC-beta` = col_character(),
##   `BHC-delta` = col_character(),
##   `BHC-gamma (Lindane)` = col_character(),
##   `Cadmium (Dissolved)` = col_integer()
##   # ... with 38 more columns
## )
```

```
## See spec(...) for full column specifications.
```

```
## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)
```

```
## Warning: 4 parsing failures.
## row # A tibble: 4 x 5 col     row col                  expected               actual file
```

```
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following object is masked from 'package:base':
##
##     date
```

```
wq$year <- year(wq$SampleDate)
wq$month <- month(wq$SampleDate)

wq.q <- wq%>%
  group_by(year, month) %>% ##without this, values don't show??
  filter(2003<year) %>% ##only years above 2003
  filter(!(year==2004 && month < 10)) %>% #removing months outside of 2005 water year
  filter(!(year==2012 && month > 9)) %>% #removing months outside of 2012 water year
  select(month, everything()) %>% #move month column
  select(year, everything()) %>% #move year column
  summarise_if(is.numeric, mean, na.rm = TRUE) %>% #returns means of columns with numeric observations
  select_if(~sum(!is.na(.)) > 0) %>% #removes columns that only have NAs
  select(-X1) %>% #removes X1 column, an index
  select_if(~sum(!is.na(.)) == 96) #cuts df to columns of the same length
```

```
wq.q
```

```
## # A tibble: 96 x 23
## # Groups: year [9]
##     year month Depth `Conductance (EC)` SiteDepth Fluorescence Oxygen
##    <dbl> <dbl> <dbl>              <dbl>     <dbl>        <dbl>  <dbl>
##  1  2004 10.0   3.00              12951      33.4         1.35   8.01
##  2  2004 11.0   3.00              12791      34.6         1.33   8.32
##  3  2004 12.0   3.00              11360      34.3         1.28   8.93
##  4  2005  1.00  3.00               6480      36.5         1.77   9.43
##  5  2005  2.00  3.00               6788      35.0         1.37   8.87
##  6  2005  3.00  3.00               4981      35.1         2.27   8.84
##  7  2005  4.00  3.00               5753      36.5         2.52   9.17
##  8  2005  5.00  3.00               3545      33.0         2.12   8.44
##  9  2005  6.00  3.00               4873      32.7         1.84   7.98
## 10  2005  7.00  3.00               6708      32.9         1.82   7.71
## # ... with 86 more rows, and 16 more variables: `Secchi Depth` <dbl>,
## #   Temperature <dbl>, Turbidity <dbl>, `Ammonia (Dissolved)` <dbl>,
## #   `Chloride (Dissolved)` <dbl>, `Chlorophyll a` <dbl>, `Kjeldahl
## #   Nitrogen (Total)` <dbl>, `Nitrite + Nitrate (Dissolved)` <dbl>,
## #   `Organic Nitrogen (Dissolved)` <dbl>, `Ortho-phosphate (Dissolved)`
## #   <dbl>, `Pheophytin a` <dbl>, `Phosphorus (Total)` <dbl>, `Silica
## #   (SiO2) (Dissolved)` <dbl>, `Solids (Total Dissolved)` <dbl>, `Solids
## #   (Total Suspended)` <dbl>, `Solids (Volatile Suspended)` <dbl>
```

what follows is kinda jumbled, I apologize if there's any confusion, I tried to document my thought process

Be sure to show your work, including multiple model comparison (or step models), provide quantification and explain the reasoning behind your final model selection.

```
lm1 <- step(lm(wq.q$`Chlorophyll a` ~ ., data = wq.q))
```

```
## Start:  AIC=107.61
## wq.q$`Chlorophyll a` ~ year + month + Depth + `Conductance (EC)` +
##     SiteDepth + Fluorescence + Oxygen + `Secchi Depth` + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Chloride (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##
## Step:  AIC=107.61
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Fluorescence + Oxygen + `Secchi Depth` + Temperature + Turbidity +
##     `Ammonia (Dissolved)` + `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
```

```
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Silica (SiO2) (Dissolved)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - Fluorescence                    1    0.0032 186.24 105.62
## - `Secchi Depth`                  1    0.0200 186.25 105.62
## - `Silica (SiO2) (Dissolved)`     1    0.0205 186.25 105.62
## - `Chloride (Dissolved)`          1    0.0554 186.29 105.64
## - `Solids (Volatile Suspended)`   1    0.0995 186.33 105.67
## - SiteDepth                       1    0.5829 186.81 105.91
## - month                           1    0.7294 186.96 105.99
## - `Phosphorus (Total)`            1    1.5496 187.78 106.41
## - `Nitrite + Nitrate (Dissolved)` 1    2.3869 188.62 106.84
## - `Ammonia (Dissolved)`           1    2.7182 188.95 107.00
## - Turbidity                       1    2.7580 188.99 107.03
## - `Solids (Total Suspended)`      1    2.8820 189.11 107.09
## - `Ortho-phosphate (Dissolved)`   1    2.9247 189.16 107.11
## - `Solids (Total Dissolved)`      1    3.0744 189.31 107.19
## <none>                                      186.23 107.61
## - year                            1    4.6113 190.84 107.96
## - `Organic Nitrogen (Dissolved)`  1    6.5009 192.73 108.91
## - `Conductance (EC)`              1    7.3944 193.63 109.35
## - `Kjeldahl Nitrogen (Total)`     1    9.6542 195.89 110.47
## - Oxygen                          1   15.6571 201.89 113.36
## - Temperature                     1   24.7753 211.01 117.60
## - `Pheophytin a`                  1   25.5385 211.77 117.95
##
## Step:  AIC=105.62
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Oxygen + `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - `Silica (SiO2) (Dissolved)`     1    0.0180 186.25 103.62
## - `Secchi Depth`                  1    0.0191 186.25 103.63
## - `Chloride (Dissolved)`          1    0.0550 186.29 103.64
## - `Solids (Volatile Suspended)`   1    0.0976 186.33 103.67
## - SiteDepth                       1    0.5798 186.81 103.91
## - month                           1    0.7471 186.98 104.00
## - `Phosphorus (Total)`            1    1.5758 187.81 104.42
## - `Nitrite + Nitrate (Dissolved)` 1    2.3862 188.62 104.84
## - `Ammonia (Dissolved)`           1    2.7533 188.99 105.03
## - Turbidity                       1    2.8199 189.06 105.06
## - `Ortho-phosphate (Dissolved)`   1    2.9225 189.16 105.11
## - `Solids (Total Suspended)`      1    2.9996 189.24 105.15
## - `Solids (Total Dissolved)`      1    3.0778 189.31 105.19
## <none>                                      186.24 105.62
## - year                            1    5.7609 192.00 106.54
```

```
## - `Organic Nitrogen (Dissolved)`   1    6.4978 192.73 106.91
## - `Conductance (EC)`               1    7.4139 193.65 107.36
## - `Kjeldahl Nitrogen (Total)`      1    9.8115 196.05 108.55
## - Oxygen                           1   16.2468 202.48 111.64
## - Temperature                      1   25.2664 211.50 115.83
## - `Pheophytin a`                   1   27.7570 213.99 116.95
##
## Step:  AIC=103.62
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Oxygen + `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - `Secchi Depth`                  1    0.0276 186.28 101.64
## - `Chloride (Dissolved)`          1    0.0533 186.31 101.65
## - `Solids (Volatile Suspended)`   1    0.0881 186.34 101.67
## - SiteDepth                       1    0.5621 186.82 101.91
## - month                           1    0.7522 187.01 102.01
## - `Phosphorus (Total)`            1    1.5601 187.81 102.43
## - `Nitrite + Nitrate (Dissolved)` 1    2.3766 188.63 102.84
## - `Ammonia (Dissolved)`           1    2.7744 189.03 103.04
## - Turbidity                       1    2.8907 189.14 103.10
## - `Ortho-phosphate (Dissolved)`   1    2.9097 189.16 103.11
## - `Solids (Total Dissolved)`      1    3.0618 189.31 103.19
## - `Solids (Total Suspended)`      1    3.0689 189.32 103.19
## <none>                                       186.25 103.62
## - year                            1    5.7937 192.05 104.57
## - `Organic Nitrogen (Dissolved)`  1    6.4810 192.73 104.91
## - `Conductance (EC)`              1    7.4315 193.69 105.38
## - `Kjeldahl Nitrogen (Total)`     1    9.8170 196.07 106.56
## - Oxygen                          1   16.3003 202.55 109.68
## - Temperature                     1   25.2508 211.50 113.83
## - `Pheophytin a`                  1   27.8466 214.10 115.00
##
## Step:  AIC=101.64
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Chloride (Dissolved)`          1    0.0585 186.34  99.669
## - `Solids (Volatile Suspended)`   1    0.0837 186.37  99.682
## - SiteDepth                       1    0.5693 186.85  99.932
## - month                           1    0.7553 187.04 100.028
## - `Phosphorus (Total)`            1    1.5614 187.84 100.441
## - `Nitrite + Nitrate (Dissolved)` 1    2.4788 188.76 100.908
## - Turbidity                       1    2.8647 189.15 101.104
## - `Ammonia (Dissolved)`           1    2.8785 189.16 101.111
```

```
## - `Ortho-phosphate (Dissolved)`    1    2.9889 189.27 101.167
## - `Solids (Total Dissolved)`       1    3.0345 189.32 101.190
## - `Solids (Total Suspended)`       1    3.5150 189.80 101.434
## <none>                                     186.28 101.639
## - `Organic Nitrogen (Dissolved)`   1    6.5140 192.79 102.939
## - `Conductance (EC)`               1    7.5671 193.85 103.462
## - year                             1    7.8646 194.15 103.609
## - `Kjeldahl Nitrogen (Total)`      1    9.9249 196.21 104.622
## - Oxygen                           1   16.2780 202.56 107.682
## - Temperature                      1   25.2787 211.56 111.855
## - `Pheophytin a`                   1   27.8339 214.12 113.008
##
## Step:  AIC=99.67
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Solids (Volatile Suspended)`   1    0.0599 186.40  97.700
## - SiteDepth                       1    0.5830 186.92  97.969
## - month                           1    0.8191 187.16  98.090
## - `Phosphorus (Total)`            1    1.5393 187.88  98.459
## - `Nitrite + Nitrate (Dissolved)` 1    2.4616 188.80  98.929
## - `Ammonia (Dissolved)`           1    2.8846 189.22  99.144
## - `Ortho-phosphate (Dissolved)`   1    2.9649 189.31  99.185
## - Turbidity                       1    2.9658 189.31  99.185
## <none>                                     186.34  99.669
## - `Solids (Total Suspended)`      1    3.9642 190.30  99.690
## - `Organic Nitrogen (Dissolved)`  1    6.5103 192.85 100.966
## - `Conductance (EC)`              1    7.5117 193.85 101.463
## - year                            1    7.8421 194.18 101.627
## - `Kjeldahl Nitrogen (Total)`     1    9.8876 196.23 102.633
## - `Solids (Total Dissolved)`      1   11.1225 197.46 103.235
## - Oxygen                          1   16.2357 202.57 105.689
## - Temperature                     1   25.2459 211.59 109.867
## - `Pheophytin a`                  1   27.9301 214.27 111.077
##
## Step:  AIC=97.7
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + SiteDepth +
##     Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - SiteDepth                       1    0.6772 187.08  96.048
## - month                           1    0.8205 187.22  96.122
## - `Phosphorus (Total)`            1    1.5697 187.97  96.505
## - `Nitrite + Nitrate (Dissolved)` 1    2.4127 188.81  96.935
## - `Ortho-phosphate (Dissolved)`   1    2.9073 189.31  97.186
```

```
## - `Ammonia (Dissolved)`            1    2.9397 189.34  97.202
## - Turbidity                        1    3.0484 189.45  97.258
## <none>                                       186.40  97.700
## - `Organic Nitrogen (Dissolved)`   1    6.5341 192.93  99.008
## - `Solids (Total Suspended)`       1    6.9232 193.32  99.201
## - `Conductance (EC)`               1    7.4518 193.85  99.463
## - year                             1    8.3183 194.72  99.892
## - `Kjeldahl Nitrogen (Total)`      1   10.1294 196.53 100.780
## - `Solids (Total Dissolved)`       1   11.0935 197.49 101.250
## - Oxygen                           1   16.4267 202.83 103.808
## - Temperature                      1   25.6658 212.06 108.084
## - `Pheophytin a`                   1   27.8754 214.28 109.080
##
## Step:  AIC=96.05
## wq.q$`Chlorophyll a` ~ year + month + `Conductance (EC)` + Oxygen +
##     Temperature + Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - month                           1    0.8423 187.92  94.480
## - `Phosphorus (Total)`            1    1.3354 188.41  94.731
## - `Nitrite + Nitrate (Dissolved)` 1    2.2440 189.32  95.193
## - `Ammonia (Dissolved)`           1    2.6590 189.74  95.403
## - `Ortho-phosphate (Dissolved)`   1    2.6666 189.74  95.407
## - Turbidity                       1    3.7807 190.86  95.969
## <none>                                       187.08  96.048
## - `Organic Nitrogen (Dissolved)`  1    6.2537 193.33  97.205
## - `Conductance (EC)`              1    6.7799 193.86  97.466
## - `Solids (Total Suspended)`      1    7.2883 194.37  97.717
## - year                            1    7.7631 194.84  97.952
## - `Kjeldahl Nitrogen (Total)`     1    9.6184 196.69  98.861
## - `Solids (Total Dissolved)`      1   10.5708 197.65  99.325
## - Oxygen                          1   16.6708 203.75 102.243
## - Temperature                     1   26.0028 213.08 106.542
## - `Pheophytin a`                  1   27.8513 214.93 107.372
##
## Step:  AIC=94.48
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Phosphorus (Total)`            1    1.3550 189.27  93.169
## - `Nitrite + Nitrate (Dissolved)` 1    2.0780 190.00  93.535
## - `Ortho-phosphate (Dissolved)`   1    3.2215 191.14  94.111
## - `Ammonia (Dissolved)`           1    3.4291 191.35  94.216
## <none>                                       187.92  94.480
## - Turbidity                       1    4.2423 192.16  94.623
## - `Organic Nitrogen (Dissolved)`  1    5.9290 193.85  95.462
## - `Conductance (EC)`              1    6.9788 194.90  95.980
```

```
## - `Solids (Total Suspended)`       1    7.2698 195.19  96.123
## - year                             1    8.5429 196.46  96.748
## - `Kjeldahl Nitrogen (Total)`      1    9.7814 197.70  97.351
## - `Solids (Total Dissolved)`       1   10.0146 197.93  97.464
## - Oxygen                           1   21.8026 209.72 103.018
## - Temperature                      1   28.2383 216.16 105.919
## - `Pheophytin a`                   1   29.0586 216.98 106.283
##
## Step:  AIC=93.17
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS     AIC
## - `Nitrite + Nitrate (Dissolved)`  1    1.4708 190.75  91.913
## - `Ortho-phosphate (Dissolved)`    1    1.8666 191.14  92.111
## - `Ammonia (Dissolved)`            1    2.9155 192.19  92.637
## - Turbidity                        1    3.1263 192.40  92.742
## <none>                                         189.27  93.169
## - `Organic Nitrogen (Dissolved)`   1    5.3607 194.63  93.851
## - `Conductance (EC)`               1    8.4515 197.73  95.363
## - `Solids (Total Suspended)`       1    8.4545 197.73  95.364
## - `Kjeldahl Nitrogen (Total)`      1    8.5878 197.86  95.429
## - year                             1   10.4606 199.74  96.334
## - `Solids (Total Dissolved)`       1   10.6721 199.95  96.435
## - Oxygen                           1   20.6414 209.91 101.106
## - Temperature                      1   27.1759 216.45 104.049
## - `Pheophytin a`                   1   27.9862 217.26 104.408
##
## Step:  AIC=91.91
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Ortho-phosphate (Dissolved)`   1    0.8703 191.62  90.350
## - Turbidity                       1    2.9617 193.71  91.392
## - `Ammonia (Dissolved)`           1    3.2703 194.01  91.544
## <none>                                        190.75  91.913
## - `Organic Nitrogen (Dissolved)`  1    6.6723 197.42  93.213
## - `Solids (Total Suspended)`      1    7.4742 198.22  93.602
## - `Kjeldahl Nitrogen (Total)`     1    7.7076 198.45  93.715
## - `Conductance (EC)`              1    8.6627 199.41  94.176
## - `Solids (Total Dissolved)`      1    9.6137 200.36  94.633
## - year                            1    9.8999 200.65  94.770
## - Oxygen                          1   19.4608 210.21  99.239
## - `Pheophytin a`                  1   26.9131 217.66 102.583
## - Temperature                     1   29.3874 220.13 103.669
##
## Step:  AIC=90.35
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
```

```
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Organic Nitrogen (Dissolved)` + `Pheophytin a` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Ammonia (Dissolved)`          1     2.804 194.42  89.744
## - Turbidity                      1     3.607 195.22  90.140
## <none>                                       191.62  90.350
## - `Organic Nitrogen (Dissolved)`  1     5.942 197.56  91.281
## - `Solids (Total Suspended)`     1     7.638 199.25  92.102
## - `Conductance (EC)`             1     8.082 199.70  92.316
## - year                           1     9.364 200.98  92.930
## - `Solids (Total Dissolved)`     1     9.729 201.34  93.104
## - `Kjeldahl Nitrogen (Total)`    1    11.205 202.82  93.805
## - Oxygen                         1    19.069 210.68  97.457
## - `Pheophytin a`                 1    26.281 217.90 100.688
## - Temperature                    1    31.863 223.48 103.117
##
## Step:  AIC=89.74
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     Turbidity + `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - Turbidity                      1     3.294 197.71  89.357
## <none>                                       194.42  89.744
## - `Organic Nitrogen (Dissolved)`  1     4.099 198.52  89.747
## - `Solids (Total Suspended)`     1     6.209 200.63  90.762
## - `Kjeldahl Nitrogen (Total)`    1     8.402 202.82  91.806
## - `Conductance (EC)`             1     9.705 204.12  92.420
## - `Solids (Total Dissolved)`     1     9.886 204.31  92.506
## - year                           1    14.339 208.76  94.576
## - `Pheophytin a`                 1    23.625 218.04  98.753
## - Oxygen                         1    24.070 218.49  98.949
## - Temperature                    1    48.110 242.53 108.970
##
## Step:  AIC=89.36
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Solids (Total Suspended)`     1     3.010 200.72  88.808
## - `Organic Nitrogen (Dissolved)`  1     3.119 200.83  88.860
## <none>                                       197.71  89.357
## - `Solids (Total Dissolved)`     1     7.774 205.49  91.060
## - `Kjeldahl Nitrogen (Total)`    1     9.715 207.43  91.962
## - `Conductance (EC)`             1    10.901 208.61  92.509
## - year                           1    13.508 211.22  93.702
## - Oxygen                         1    20.976 218.69  97.037
## - `Pheophytin a`                 1    23.139 220.85  97.982
## - Temperature                    1    44.952 242.66 107.024
##
## Step:  AIC=88.81
```

```
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Dissolved)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Organic Nitrogen (Dissolved)`  1     2.441 203.16  87.968
## <none>                                        200.72  88.808
## - `Kjeldahl Nitrogen (Total)`     1     7.721 208.44  90.431
## - `Solids (Total Dissolved)`      1     9.876 210.60  91.418
## - year                            1    10.549 211.27  91.725
## - `Conductance (EC)`              1    11.611 212.34  92.206
## - `Pheophytin a`                  1    20.155 220.88  95.993
## - Oxygen                          1    28.059 228.78  99.369
## - Temperature                     1    52.495 253.22 109.111
##
## Step:  AIC=87.97
## wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
##     `Kjeldahl Nitrogen (Total)` + `Pheophytin a` + `Solids (Total Dissolved)`
##
##                               Df Sum of Sq    RSS     AIC
## <none>                                      203.16  87.968
## - `Kjeldahl Nitrogen (Total)`  1     5.955 209.12  88.742
## - `Solids (Total Dissolved)`   1     8.732 211.90  90.008
## - `Conductance (EC)`           1    10.063 213.23  90.609
## - year                         1    11.708 214.87  91.347
## - `Pheophytin a`               1    23.020 226.19  96.272
## - Oxygen                       1    27.495 230.66  98.153
## - Temperature                  1    51.673 254.84 107.723
```

```
lm1
```

```
##
## Call:
## lm(formula = wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` +
##     Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` + `Pheophytin a` +
##     `Solids (Total Dissolved)`, data = wq.q)
##
## Coefficients:
##                 (Intercept)                         year
##                  -3.593e+02                    1.651e-01
##          `Conductance (EC)`                       Oxygen
##                  -3.842e-04                    2.198e+00
##                 Temperature  `Kjeldahl Nitrogen (Total)`
##                   6.064e-01                    2.615e+00
##               `Pheophytin a`   `Solids (Total Dissolved)`
##                   9.105e-01                    6.480e-04
```

```
#Step:  AIC=87.97
#wq.q$`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature +
    #`Kjeldahl Nitrogen (Total)` + `Pheophytin a` + `Solids (Total Dissolved)`

#this model has the fewest variables and the lowest AIC, so it is the most parsimonious while still acc

##after doing my multicollinearity analyses above I noticed that EC and dissolved solids are correlated
```

```r
steplm <- step(lm(wq.q$`Chlorophyll a` ~ year + month+
    SiteDepth + Fluorescence + Oxygen + `Secchi Depth` + Temperature +
    Turbidity + `Ammonia (Dissolved)` + `Chloride (Dissolved)` +
    `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
    `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
    `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
    `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
    `Solids (Volatile Suspended)`, data = wq.q))
```

```
## Start:  AIC=109.35
## wq.q$`Chlorophyll a` ~ year + month + SiteDepth + Fluorescence +
##     Oxygen + `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##                                   Df Sum of Sq    RSS    AIC
## - `Solids (Volatile Suspended)`    1    0.0003 193.63 107.35
## - SiteDepth                        1    0.0026 193.63 107.35
## - `Chloride (Dissolved)`           1    0.0073 193.63 107.36
## - Fluorescence                     1    0.0227 193.65 107.36
## - `Silica (SiO2) (Dissolved)`      1    0.0232 193.65 107.36
## - `Secchi Depth`                   1    0.1179 193.75 107.41
## - `Solids (Total Dissolved)`       1    0.3103 193.94 107.51
## - month                            1    0.5815 194.21 107.64
## - `Phosphorus (Total)`             1    2.3698 196.00 108.52
## - `Nitrite + Nitrate (Dissolved)`  1    2.7565 196.38 108.71
## - `Ortho-phosphate (Dissolved)`    1    2.8490 196.48 108.75
## - year                             1    3.0895 196.72 108.87
## - `Ammonia (Dissolved)`            1    3.8127 197.44 109.22
## <none>                                       193.63 109.35
## - `Organic Nitrogen (Dissolved)`   1    5.0361 198.66 109.82
## - Turbidity                        1    5.2391 198.87 109.92
## - `Solids (Total Suspended)`       1    5.3860 199.01 109.99
## - `Kjeldahl Nitrogen (Total)`      1   11.9153 205.54 113.08
## - Oxygen                           1   18.9601 212.59 116.32
## - Temperature                      1   28.4349 222.06 120.51
## - `Pheophytin a`                   1   29.5148 223.14 120.97
##
## Step:  AIC=107.35
## wq.q$`Chlorophyll a` ~ year + month + SiteDepth + Fluorescence +
##     Oxygen + `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS    AIC
## - SiteDepth                        1    0.0024 193.63 105.35
## - `Chloride (Dissolved)`           1    0.0069 193.63 105.36
## - Fluorescence                     1    0.0231 193.65 105.36
## - `Silica (SiO2) (Dissolved)`      1    0.0250 193.65 105.36
```

```
## - `Secchi Depth`                   1    0.1182 193.75 105.41
## - `Solids (Total Dissolved)`       1    0.3197 193.95 105.51
## - month                            1    0.5838 194.21 105.64
## - `Phosphorus (Total)`             1    2.3735 196.00 106.52
## - `Nitrite + Nitrate (Dissolved)`  1    2.7925 196.42 106.73
## - `Ortho-phosphate (Dissolved)`    1    2.8950 196.52 106.78
## - year                             1    3.5443 197.17 107.09
## - `Ammonia (Dissolved)`            1    3.8400 197.47 107.24
## <none>                                       193.63 107.35
## - `Organic Nitrogen (Dissolved)`   1    5.0397 198.67 107.82
## - Turbidity                        1    5.2419 198.87 107.92
## - `Solids (Total Suspended)`       1    8.6032 202.23 109.53
## - `Kjeldahl Nitrogen (Total)`      1   12.0650 205.69 111.16
## - Oxygen                           1   18.9640 212.59 114.32
## - Temperature                      1   28.4449 222.07 118.51
## - `Pheophytin a`                   1   30.2754 223.90 119.30
##
## Step:  AIC=105.35
## wq.q$`Chlorophyll a` ~ year + month + Fluorescence + Oxygen +
##     `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Chloride (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - `Chloride (Dissolved)`          1    0.0068 193.64 103.36
## - `Silica (SiO2) (Dissolved)`     1    0.0229 193.65 103.36
## - Fluorescence                    1    0.0263 193.66 103.37
## - `Secchi Depth`                  1    0.1237 193.75 103.42
## - `Solids (Total Dissolved)`      1    0.3265 193.96 103.52
## - month                           1    0.5816 194.21 103.64
## - `Phosphorus (Total)`            1    2.4899 196.12 104.58
## - `Nitrite + Nitrate (Dissolved)` 1    2.8612 196.49 104.76
## - `Ortho-phosphate (Dissolved)`   1    2.9648 196.59 104.81
## - year                            1    3.7041 197.33 105.17
## - `Ammonia (Dissolved)`           1    3.9395 197.57 105.29
## <none>                                      193.63 105.35
## - `Organic Nitrogen (Dissolved)`  1    5.0640 198.69 105.83
## - Turbidity                       1    5.2893 198.92 105.94
## - `Solids (Total Suspended)`      1    8.6018 202.23 107.53
## - `Kjeldahl Nitrogen (Total)`     1   12.4427 206.07 109.33
## - Oxygen                          1   19.0022 212.63 112.34
## - Temperature                     1   28.4871 222.12 116.53
## - `Pheophytin a`                  1   30.6705 224.30 117.47
##
## Step:  AIC=103.36
## wq.q$`Chlorophyll a` ~ year + month + Fluorescence + Oxygen +
##     `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
```

```
##                                   Df Sum of Sq    RSS    AIC
## - `Silica (SiO2) (Dissolved)`      1    0.0227 193.66 101.37
## - Fluorescence                     1    0.0275 193.66 101.37
## - `Secchi Depth`                   1    0.1197 193.76 101.42
## - month                            1    0.6097 194.25 101.66
## - `Phosphorus (Total)`             1    2.4832 196.12 102.58
## - `Nitrite + Nitrate (Dissolved)`  1    2.8571 196.49 102.76
## - `Ortho-phosphate (Dissolved)`    1    2.9607 196.60 102.81
## - year                             1    3.7161 197.35 103.18
## - `Solids (Total Dissolved)`       1    3.7759 197.41 103.21
## - `Ammonia (Dissolved)`            1    3.9343 197.57 103.29
## <none>                                       193.64 103.36
## - `Organic Nitrogen (Dissolved)`   1    5.0625 198.70 103.83
## - Turbidity                        1    5.3636 199.00 103.98
## - `Solids (Total Suspended)`       1    8.7683 202.41 105.61
## - `Kjeldahl Nitrogen (Total)`      1   12.4569 206.09 107.34
## - Oxygen                           1   18.9995 212.64 110.34
## - Temperature                      1   28.4825 222.12 114.53
## - `Pheophytin a`                   1   30.7881 224.42 115.52
##
## Step:  AIC=101.37
## wq.q$`Chlorophyll a` ~ year + month + Fluorescence + Oxygen +
##     `Secchi Depth` + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS     AIC
## - Fluorescence                     1    0.0355 193.69  99.386
## - `Secchi Depth`                   1    0.1440 193.80  99.439
## - month                            1    0.6035 194.26  99.667
## - `Phosphorus (Total)`             1    2.5628 196.22 100.630
## - `Nitrite + Nitrate (Dissolved)`  1    2.9593 196.62 100.824
## - `Ortho-phosphate (Dissolved)`    1    3.0225 196.68 100.855
## - year                             1    3.8495 197.51 101.258
## - `Ammonia (Dissolved)`            1    3.9123 197.57 101.288
## - `Solids (Total Dissolved)`       1    3.9966 197.66 101.329
## <none>                                       193.66 101.368
## - `Organic Nitrogen (Dissolved)`   1    5.0806 198.74 101.854
## - Turbidity                        1    5.3607 199.02 101.989
## - `Solids (Total Suspended)`       1    8.7745 202.43 103.622
## - `Kjeldahl Nitrogen (Total)`      1   12.4351 206.09 105.342
## - Oxygen                           1   19.0244 212.68 108.364
## - Temperature                      1   28.6822 222.34 112.627
## - `Pheophytin a`                   1   31.3786 225.04 113.784
##
## Step:  AIC=99.39
## wq.q$`Chlorophyll a` ~ year + month + Oxygen + `Secchi Depth` +
##     Temperature + Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
```

```
##                                   Df Sum of Sq    RSS     AIC
## - `Secchi Depth`                   1     0.162 193.86  97.466
## - month                            1     0.635 194.33  97.700
## - `Phosphorus (Total)`             1     2.702 196.40  98.716
## - `Nitrite + Nitrate (Dissolved)`  1     2.962 196.66  98.843
## - `Ortho-phosphate (Dissolved)`    1     3.037 196.73  98.879
## - `Ammonia (Dissolved)`            1     4.005 197.70  99.350
## - `Solids (Total Dissolved)`       1     4.029 197.72  99.362
## <none>                                         193.69  99.386
## - year                             1     4.199 197.89  99.444
## - `Organic Nitrogen (Dissolved)`   1     5.067 198.76  99.865
## - Turbidity                        1     5.433 199.13 100.041
## - `Solids (Total Suspended)`       1     8.780 202.47 101.642
## - `Kjeldahl Nitrogen (Total)`      1    12.742 206.44 103.502
## - Oxygen                           1    19.504 213.20 106.596
## - Temperature                      1    29.045 222.74 110.799
## - `Pheophytin a`                   1    32.651 226.35 112.341
##
## Step:  AIC=97.47
## wq.q$`Chlorophyll a` ~ year + month + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS     AIC
## - month                            1     1.041 194.90  95.980
## - `Phosphorus (Total)`             1     2.770 196.63  96.828
## - `Nitrite + Nitrate (Dissolved)`  1     2.847 196.70  96.866
## - `Ortho-phosphate (Dissolved)`    1     2.938 196.79  96.910
## - `Solids (Total Dissolved)`       1     3.871 197.73  97.364
## - `Ammonia (Dissolved)`            1     3.900 197.76  97.378
## <none>                                         193.86  97.466
## - year                             1     4.748 198.60  97.789
## - `Organic Nitrogen (Dissolved)`   1     4.986 198.84  97.904
## - Turbidity                        1     5.870 199.73  98.330
## - `Solids (Total Suspended)`       1     8.893 202.75  99.772
## - `Kjeldahl Nitrogen (Total)`      1    12.695 206.55 101.555
## - Oxygen                           1    19.766 213.62 104.787
## - Temperature                      1    29.907 223.76 109.239
## - `Pheophytin a`                   1    33.277 227.13 110.674
##
## Step:  AIC=95.98
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS     AIC
## - `Nitrite + Nitrate (Dissolved)`  1     2.647 197.54  95.275
## - `Phosphorus (Total)`             1     2.828 197.73  95.363
## - `Solids (Total Dissolved)`       1     3.057 197.96  95.474
## - `Ortho-phosphate (Dissolved)`    1     3.590 198.49  95.732
```

```
## <none>                                       194.90  95.980
## - `Organic Nitrogen (Dissolved)`   1     4.640 199.54  96.239
## - `Ammonia (Dissolved)`            1     4.992 199.89  96.408
## - year                             1     5.363 200.26  96.586
## - Turbidity                        1     6.573 201.47  97.165
## - `Solids (Total Suspended)`       1     8.894 203.79  98.264
## - `Kjeldahl Nitrogen (Total)`      1    12.958 207.86 100.160
## - Oxygen                           1    26.175 221.07 106.078
## - Temperature                      1    32.688 227.59 108.865
## - `Pheophytin a`                   1    34.886 229.78 109.788
##
## Step:  AIC=95.28
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Solids (Total Dissolved)`      1     1.382 198.93  93.944
## - `Ortho-phosphate (Dissolved)`   1     1.652 199.20  94.075
## - `Phosphorus (Total)`            1     1.863 199.41  94.176
## <none>                                      197.54  95.275
## - year                            1     4.999 202.54  95.675
## - `Ammonia (Dissolved)`           1     5.418 202.96  95.873
## - Turbidity                       1     5.806 203.35  96.056
## - `Organic Nitrogen (Dissolved)`  1     5.846 203.39  96.075
## - `Solids (Total Suspended)`      1     7.784 205.33  96.985
## - `Kjeldahl Nitrogen (Total)`     1    10.971 208.52  98.464
## - Oxygen                          1    24.111 221.66 104.331
## - `Pheophytin a`                  1    32.466 230.01 107.883
## - Temperature                     1    35.252 232.80 109.038
##
## Step:  AIC=93.94
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Phosphorus (Total)`            1     1.633 200.56  92.729
## - `Ortho-phosphate (Dissolved)`   1     2.307 201.23  93.051
## <none>                                      198.93  93.944
## - `Ammonia (Dissolved)`           1     4.596 203.52  94.137
## - Turbidity                       1     5.103 204.03  94.376
## - `Organic Nitrogen (Dissolved)`  1     5.664 204.59  94.639
## - year                            1     5.909 204.84  94.754
## - `Solids (Total Suspended)`      1     6.615 205.54  95.085
## - `Kjeldahl Nitrogen (Total)`     1    10.475 209.40  96.871
## - Oxygen                          1    22.897 221.82 102.403
## - `Pheophytin a`                  1    33.234 232.16 106.776
## - Temperature                     1    34.093 233.02 107.131
##
## Step:  AIC=92.73
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
```

```
##     `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Ortho-phosphate (Dissolved)`  1     0.803 201.36  91.113
## - Turbidity                      1     3.708 204.27  92.488
## - `Ammonia (Dissolved)`          1     4.025 204.59  92.637
## <none>                                       200.56  92.729
## - `Organic Nitrogen (Dissolved)` 1     4.794 205.35  92.997
## - year                           1     7.262 207.82  94.144
## - `Solids (Total Suspended)`     1     8.792 209.35  94.848
## - `Kjeldahl Nitrogen (Total)`    1     8.866 209.43  94.882
## - Oxygen                         1    22.075 222.63 100.754
## - Temperature                    1    32.894 233.45 105.309
## - `Pheophytin a`                 1    32.946 233.50 105.330
##
## Step:  AIC=91.11
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Ammonia (Dissolved)`          1     3.376 204.74  90.709
## - Turbidity                      1     3.388 204.75  90.715
## - `Organic Nitrogen (Dissolved)` 1     4.169 205.53  91.080
## <none>                                       201.36  91.113
## - year                           1     7.046 208.41  92.414
## - `Solids (Total Suspended)`     1     8.433 209.80  93.051
## - `Kjeldahl Nitrogen (Total)`    1    12.558 213.92  94.921
## - Oxygen                         1    21.274 222.64  98.754
## - `Pheophytin a`                 1    32.259 233.62 103.378
## - Temperature                    1    33.842 235.20 104.026
##
## Step:  AIC=90.71
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Organic Nitrogen (Dissolved)` 1     2.382 207.12  89.819
## <none>                                       204.74  90.709
## - Turbidity                      1     5.350 210.09  91.185
## - `Solids (Total Suspended)`     1     7.409 212.15  92.122
## - `Kjeldahl Nitrogen (Total)`    1     9.183 213.92  92.921
## - year                           1    10.856 215.59  93.669
## - `Pheophytin a`                 1    29.067 233.81 101.454
## - Oxygen                         1    33.294 238.03 103.174
## - Temperature                    1    63.006 267.75 114.466
##
## Step:  AIC=89.82
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + Turbidity +
##     `Kjeldahl Nitrogen (Total)` + `Pheophytin a` + `Solids (Total Suspended)`
##
##                               Df Sum of Sq    RSS     AIC
```

```
## - Turbidity                     1     3.944 211.06  89.630
## <none>                                  207.12  89.819
## - `Solids (Total Suspended)`    1     5.967 213.09  90.546
## - `Kjeldahl Nitrogen (Total)`   1     8.048 215.17  91.479
## - year                          1    11.511 218.63  93.012
## - `Pheophytin a`                1    30.421 237.54 100.975
## - Oxygen                        1    32.121 239.24 101.660
## - Temperature                   1    61.241 268.36 112.687
##
## Step:  AIC=89.63
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +
##     `Pheophytin a` + `Solids (Total Suspended)`
##
##                                Df Sum of Sq    RSS     AIC
## - `Solids (Total Suspended)`    1     2.277 213.34  88.660
## <none>                                  211.06  89.630
## - year                          1     9.367 220.43  91.799
## - `Kjeldahl Nitrogen (Total)`   1     9.808 220.87  91.991
## - `Pheophytin a`                1    27.891 238.96  99.545
## - Oxygen                        1    35.764 246.83 102.657
## - Temperature                   1    61.788 272.85 112.280
##
## Step:  AIC=88.66
## wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +
##     `Pheophytin a`
##
##                                Df Sum of Sq    RSS     AIC
## <none>                                  213.34  88.660
## - year                          1     7.145 220.49  89.823
## - `Kjeldahl Nitrogen (Total)`   1     8.441 221.78  90.385
## - `Pheophytin a`                1    25.857 239.20  97.643
## - Oxygen                        1    40.352 253.69 103.291
## - Temperature                   1    66.493 279.83 112.705
```

```
steplm
```

```
##
## Call:
## lm(formula = wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature +
##     `Kjeldahl Nitrogen (Total)` + `Pheophytin a`, data = wq.q)
##
## Coefficients:
##                  (Intercept)                          year
##                    -281.2641                        0.1243
##                       Oxygen                   Temperature
##                       2.4849                        0.6609
## `Kjeldahl Nitrogen (Total)`                 `Pheophytin a`
##                       3.0764                        0.9614
```

```
#Step:  AIC=88.66; wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +

#I'm going to use this model because it is more parsimonious, and i think it's fair to take out EC sinc
```

```r
steplmyrrm <- step(lm(wq.q$`Chlorophyll a` ~
    SiteDepth + Fluorescence + Oxygen + `Secchi Depth` + Temperature +
    Turbidity + `Ammonia (Dissolved)` + `Chloride (Dissolved)` +
    `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
    `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
    `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
    `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
    `Solids (Volatile Suspended)`, data = wq.q))
```

```
## Start:  AIC=107.75
## wq.q$`Chlorophyll a` ~ SiteDepth + Fluorescence + Oxygen + `Secchi Depth` +
##     Temperature + Turbidity + `Ammonia (Dissolved)` + `Chloride (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - `Secchi Depth`                  1     0.008 198.54 105.76
## - `Chloride (Dissolved)`          1     0.035 198.56 105.77
## - SiteDepth                       1     0.052 198.58 105.78
## - `Solids (Total Dissolved)`      1     0.112 198.64 105.81
## - `Silica (SiO2) (Dissolved)`     1     0.321 198.85 105.91
## - `Solids (Volatile Suspended)`   1     0.602 199.13 106.04
## - Fluorescence                    1     0.731 199.26 106.11
## - `Nitrite + Nitrate (Dissolved)` 1     1.793 200.32 106.62
## - `Ortho-phosphate (Dissolved)`   1     3.034 201.56 107.21
## - `Phosphorus (Total)`            1     3.583 202.11 107.47
## <none>                                      198.53 107.75
## - `Solids (Total Suspended)`      1     5.058 203.59 108.17
## - `Organic Nitrogen (Dissolved)`  1     5.592 204.12 108.42
## - Turbidity                       1     5.639 204.17 108.44
## - `Ammonia (Dissolved)`           1     7.908 206.44 109.50
## - `Kjeldahl Nitrogen (Total)`     1    15.885 214.41 113.14
## - `Pheophytin a`                  1    26.235 224.76 117.67
## - Oxygen                          1    27.104 225.63 118.04
## - Temperature                     1    33.136 231.66 120.57
##
## Step:  AIC=105.76
## wq.q$`Chlorophyll a` ~ SiteDepth + Fluorescence + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Chloride (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Silica (SiO2) (Dissolved)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS    AIC
## - `Chloride (Dissolved)`          1     0.036 198.57 103.77
## - SiteDepth                       1     0.049 198.59 103.78
## - `Solids (Total Dissolved)`      1     0.117 198.65 103.81
## - `Silica (SiO2) (Dissolved)`     1     0.313 198.85 103.91
## - `Solids (Volatile Suspended)`   1     0.656 199.19 104.07
```

```
## - Fluorescence                       1     0.895 199.43 104.19
## - `Nitrite + Nitrate (Dissolved)`    1     1.833 200.37 104.64
## - `Ortho-phosphate (Dissolved)`      1     3.047 201.59 105.22
## - `Phosphorus (Total)`               1     3.634 202.17 105.50
## <none>                                           198.54 105.76
## - `Solids (Total Suspended)`         1     5.445 203.98 106.35
## - `Organic Nitrogen (Dissolved)`     1     5.726 204.26 106.49
## - Turbidity                          1     5.855 204.39 106.55
## - `Ammonia (Dissolved)`              1     8.106 206.64 107.60
## - `Kjeldahl Nitrogen (Total)`        1    16.212 214.75 111.29
## - Oxygen                             1    27.690 226.23 116.29
## - `Pheophytin a`                     1    28.087 226.62 116.46
## - Temperature                        1    33.593 232.13 118.76
##
## Step:  AIC=103.77
## wq.q$`Chlorophyll a` ~ SiteDepth + Fluorescence + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Silica (SiO2) (Dissolved)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                    Df Sum of Sq    RSS    AIC
## - SiteDepth                         1     0.045 198.62 101.80
## - `Silica (SiO2) (Dissolved)`       1     0.316 198.89 101.93
## - `Solids (Volatile Suspended)`     1     0.759 199.33 102.14
## - Fluorescence                      1     0.900 199.47 102.21
## - `Nitrite + Nitrate (Dissolved)`   1     1.817 200.39 102.65
## - `Solids (Total Dissolved)`        1     2.572 201.15 103.01
## - `Ortho-phosphate (Dissolved)`     1     3.038 201.61 103.23
## - `Phosphorus (Total)`              1     3.607 202.18 103.50
## <none>                                          198.57 103.77
## - `Organic Nitrogen (Dissolved)`    1     5.723 204.30 104.50
## - `Solids (Total Suspended)`        1     5.965 204.54 104.62
## - Turbidity                         1     5.988 204.56 104.63
## - `Ammonia (Dissolved)`             1     8.148 206.72 105.64
## - `Kjeldahl Nitrogen (Total)`       1    16.179 214.75 109.29
## - Oxygen                            1    27.696 226.27 114.31
## - `Pheophytin a`                    1    28.155 226.73 114.50
## - Temperature                       1    33.579 232.15 116.77
##
## Step:  AIC=101.8
## wq.q$`Chlorophyll a` ~ Fluorescence + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Silica (SiO2) (Dissolved)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)` + `Solids (Volatile Suspended)`
##
##                                    Df Sum of Sq    RSS     AIC
## - `Silica (SiO2) (Dissolved)`       1     0.286 198.91  99.934
## - Fluorescence                      1     0.870 199.49 100.216
## - `Solids (Volatile Suspended)`     1     0.872 199.49 100.217
## - `Nitrite + Nitrate (Dissolved)`   1     1.881 200.50 100.701
```

```
## - `Solids (Total Dissolved)`       1     2.769 201.39 101.125
## - `Ortho-phosphate (Dissolved)`    1     3.130 201.75 101.297
## - `Phosphorus (Total)`             1     3.947 202.57 101.685
## <none>                                     198.62 101.796
## - `Organic Nitrogen (Dissolved)`   1     5.797 204.42 102.558
## - Turbidity                        1     5.945 204.56 102.627
## - `Solids (Total Suspended)`       1     6.052 204.67 102.677
## - `Ammonia (Dissolved)`            1     8.582 207.20 103.857
## - `Kjeldahl Nitrogen (Total)`      1    17.160 215.78 107.751
## - Oxygen                           1    27.865 226.48 112.399
## - `Pheophytin a`                   1    28.413 227.03 112.631
## - Temperature                      1    33.791 232.41 114.879
##
## Step:  AIC=99.93
## wq.q$`Chlorophyll a` ~ Fluorescence + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)` +
##     `Solids (Volatile Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Solids (Volatile Suspended)`   1     0.727 199.63  98.284
## - Fluorescence                    1     0.728 199.63  98.285
## - `Nitrite + Nitrate (Dissolved)` 1     2.069 200.97  98.928
## - `Solids (Total Dissolved)`      1     3.171 202.08  99.453
## - `Ortho-phosphate (Dissolved)`   1     3.346 202.25  99.536
## <none>                                    198.91  99.934
## - `Phosphorus (Total)`            1     4.323 203.23  99.998
## - `Solids (Total Suspended)`      1     5.780 204.69 100.684
## - `Organic Nitrogen (Dissolved)`  1     5.866 204.77 100.724
## - Turbidity                       1     5.990 204.90 100.783
## - `Ammonia (Dissolved)`           1     8.464 207.37 101.935
## - `Kjeldahl Nitrogen (Total)`     1    17.070 215.97 105.838
## - Oxygen                          1    28.305 227.21 110.707
## - `Pheophytin a`                  1    29.583 228.49 111.245
## - Temperature                     1    34.688 233.59 113.366
##
## Step:  AIC=98.28
## wq.q$`Chlorophyll a` ~ Fluorescence + Oxygen + Temperature +
##     Turbidity + `Ammonia (Dissolved)` + `Kjeldahl Nitrogen (Total)` +
##     `Nitrite + Nitrate (Dissolved)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - Fluorescence                    1     0.628 200.26  96.586
## - `Nitrite + Nitrate (Dissolved)` 1     2.308 201.94  97.388
## - `Solids (Total Dissolved)`      1     3.803 203.44  98.096
## - `Ortho-phosphate (Dissolved)`   1     3.846 203.48  98.116
## <none>                                    199.63  98.284
## - `Phosphorus (Total)`            1     4.563 204.19  98.454
## - Turbidity                       1     5.731 205.36  99.001
## - `Solids (Total Suspended)`      1     5.849 205.48  99.057
```

```
## - `Organic Nitrogen (Dissolved)`   1     6.058 205.69  99.154
## - `Ammonia (Dissolved)`            1     9.003 208.63 100.519
## - `Kjeldahl Nitrogen (Total)`      1    17.252 216.88 104.242
## - Oxygen                           1    28.680 228.31 109.171
## - `Pheophytin a`                   1    29.401 229.03 109.474
## - Temperature                      1    34.584 234.22 111.622
##
## Step:  AIC=96.59
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Nitrite + Nitrate (Dissolved)` +
##     `Organic Nitrogen (Dissolved)` + `Ortho-phosphate (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
##
##                                   Df Sum of Sq    RSS     AIC
## - `Nitrite + Nitrate (Dissolved)`  1     2.284 202.54  95.675
## - `Ortho-phosphate (Dissolved)`    1     3.793 204.05  96.387
## - `Solids (Total Dissolved)`       1     4.057 204.32  96.511
## <none>                                       200.26  96.586
## - `Phosphorus (Total)`             1     4.409 204.67  96.677
## - `Solids (Total Suspended)`       1     5.415 205.68  97.147
## - Turbidity                        1     6.550 206.81  97.676
## - `Organic Nitrogen (Dissolved)`   1     6.577 206.84  97.688
## - `Ammonia (Dissolved)`            1     9.266 209.53  98.928
## - `Kjeldahl Nitrogen (Total)`      1    17.240 217.50 102.514
## - `Pheophytin a`                   1    29.777 230.04 107.894
## - Oxygen                           1    32.580 232.84 109.057
## - Temperature                      1    37.283 237.54 110.976
##
## Step:  AIC=95.67
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Ortho-phosphate (Dissolved)` + `Pheophytin a` + `Phosphorus (Total)` +
##     `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                  Df Sum of Sq    RSS     AIC
## - `Ortho-phosphate (Dissolved)`   1     1.973 204.52  94.605
## - `Solids (Total Dissolved)`      1     2.291 204.84  94.754
## - `Phosphorus (Total)`            1     3.257 205.80  95.206
## <none>                                      202.54  95.675
## - `Solids (Total Suspended)`      1     4.650 207.19  95.854
## - Turbidity                       1     5.842 208.39  96.404
## - `Organic Nitrogen (Dissolved)`  1     7.860 210.40  97.330
## - `Ammonia (Dissolved)`           1     9.676 212.22  98.155
## - `Kjeldahl Nitrogen (Total)`     1    15.203 217.75 100.623
## - `Pheophytin a`                  1    27.690 230.24 105.976
## - Oxygen                          1    30.508 233.05 107.144
## - Temperature                     1    39.717 242.26 110.864
##
## Step:  AIC=94.61
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Phosphorus (Total)` + `Solids (Total Dissolved)` +
##     `Solids (Total Suspended)`
```

```
##
##                                 Df Sum of Sq    RSS     AIC
## - `Phosphorus (Total)`           1     1.389 205.91  93.255
## - `Solids (Total Dissolved)`     1     3.273 207.79  94.129
## <none>                                       204.52  94.605
## - Turbidity                      1     5.311 209.83  95.066
## - `Solids (Total Suspended)`     1     5.602 210.12  95.199
## - `Organic Nitrogen (Dissolved)` 1     6.361 210.88  95.545
## - `Ammonia (Dissolved)`          1     8.240 212.76  96.397
## - `Kjeldahl Nitrogen (Total)`    1    14.961 219.48  99.383
## - `Pheophytin a`                 1    26.355 230.87 104.242
## - Oxygen                         1    29.175 233.69 105.407
## - Temperature                    1    40.519 245.04 109.957
##
## Step:  AIC=93.25
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Dissolved)` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Solids (Total Dissolved)`     1     2.502 208.41  92.414
## - Turbidity                      1     4.108 210.01  93.152
## <none>                                       205.91  93.255
## - `Solids (Total Suspended)`     1     6.218 212.12  94.111
## - `Organic Nitrogen (Dissolved)` 1     6.494 212.40  94.236
## - `Ammonia (Dissolved)`          1     8.843 214.75  95.292
## - `Kjeldahl Nitrogen (Total)`    1    14.576 220.48  97.821
## - `Pheophytin a`                 1    26.280 232.19 102.786
## - Oxygen                         1    29.313 235.22 104.032
## - Temperature                    1    39.145 245.05 107.963
##
## Step:  AIC=92.41
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + Turbidity + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - Turbidity                      1     1.616 210.02  91.156
## - `Solids (Total Suspended)`     1     4.287 212.70  92.369
## <none>                                       208.41  92.414
## - `Organic Nitrogen (Dissolved)` 1     5.965 214.37  93.123
## - `Ammonia (Dissolved)`          1     7.187 215.59  93.669
## - `Kjeldahl Nitrogen (Total)`    1    15.792 224.20  97.426
## - `Pheophytin a`                 1    26.038 234.45 101.716
## - Oxygen                         1    26.878 235.29 102.060
## - Temperature                    1    36.668 245.08 105.973
##
## Step:  AIC=91.16
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a` + `Solids (Total Suspended)`
##
##                                 Df Sum of Sq    RSS     AIC
## - `Solids (Total Suspended)`     1     2.672 212.70  90.370
```

```
## <none>                                          210.02  91.156
## - `Organic Nitrogen (Dissolved)`  1     4.972 215.00  91.402
## - `Ammonia (Dissolved)`           1     8.672 218.70  93.040
## - `Kjeldahl Nitrogen (Total)`     1    15.771 225.79  96.107
## - `Pheophytin a`                  1    26.202 236.23 100.442
## - Oxygen                          1    26.467 236.49 100.550
## - Temperature                     1    35.202 245.22 104.032
##
## Step:  AIC=90.37
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Organic Nitrogen (Dissolved)` +
##     `Pheophytin a`
##
##                                   Df Sum of Sq    RSS     AIC
## - `Organic Nitrogen (Dissolved)`  1     3.535 216.23  89.952
## <none>                                        212.70  90.370
## - `Ammonia (Dissolved)`           1     6.159 218.85  91.110
## - `Kjeldahl Nitrogen (Total)`     1    13.123 225.82  94.117
## - `Pheophytin a`                  1    23.578 236.27  98.462
## - Oxygen                          1    32.465 245.16 102.007
## - Temperature                     1    43.165 255.86 106.107
##
## Step:  AIC=89.95
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + `Ammonia (Dissolved)` +
##     `Kjeldahl Nitrogen (Total)` + `Pheophytin a`
##
##                                Df Sum of Sq    RSS     AIC
## - `Ammonia (Dissolved)`         1     4.256 220.49  89.823
## <none>                                      216.23  89.952
## - `Kjeldahl Nitrogen (Total)`  1    11.579 227.81  92.960
## - `Pheophytin a`               1    24.101 240.33  98.096
## - Oxygen                       1    33.199 249.43 101.664
## - Temperature                  1    45.243 261.47 106.191
##
## Step:  AIC=89.82
## wq.q$`Chlorophyll a` ~ Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +
##     `Pheophytin a`
##
##                                Df Sum of Sq    RSS     AIC
## <none>                                      220.49  89.823
## - `Kjeldahl Nitrogen (Total)`  1     8.076 228.56  91.276
## - `Pheophytin a`               1    20.383 240.87  96.311
## - Oxygen                       1    53.229 273.71 108.583
## - Temperature                  1    82.085 302.57 118.205
```

```
steplmyrrm
```

```
##
## Call:
## lm(formula = wq.q$`Chlorophyll a` ~ Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +
##     `Pheophytin a`, data = wq.q)
##
## Coefficients:
##                 (Intercept)                       Oxygen
##                    -34.5666                       2.7562
```

```
##                  Temperature  `Kjeldahl Nitrogen (Total)`
##                       0.7129                       3.0083
##              `Pheophytin a`
##                       0.8190
```

Which variables are highly correlated with the others? How did you account for this?

```
wqcor <- cor(wq.q)
```

```
## Warning in cor(wq.q): the standard deviation is zero
```

```
wqcor
```

```
##                                       year       month Depth
## year                           1.00000000 -0.13975762    NA
## month                         -0.13975762  1.00000000    NA
## Depth                                  NA          NA     1
## Conductance (EC)               0.01215298  0.60983155    NA
## SiteDepth                     -0.14182501 -0.29577490    NA
## Fluorescence                   0.46254442 -0.27181851    NA
## Oxygen                         0.04842815 -0.50320596    NA
## Secchi Depth                   0.29783983  0.61849790    NA
## Temperature                    0.01692287  0.33995748    NA
## Turbidity                      0.06245805 -0.58485065    NA
## Ammonia (Dissolved)           -0.33107906  0.05697478    NA
## Chloride (Dissolved)          -0.06262702  0.57799663    NA
## Chlorophyll a                  0.11505109 -0.15652991    NA
## Kjeldahl Nitrogen (Total)     -0.12752142 -0.32329081    NA
## Nitrite + Nitrate (Dissolved) -0.18363670 -0.13057201    NA
## Organic Nitrogen (Dissolved)  -0.16432760 -0.38166794    NA
## Ortho-phosphate (Dissolved)   -0.22948148 -0.01974504    NA
## Pheophytin a                  -0.17376191 -0.16656555    NA
## Phosphorus (Total)            -0.16213924 -0.27188905    NA
## Silica (SiO2) (Dissolved)      0.01559886 -0.26115599    NA
## Solids (Total Dissolved)      -0.06592869  0.60347100    NA
## Solids (Total Suspended)       0.28699576 -0.30859902    NA
## Solids (Volatile Suspended)    0.42639771 -0.06715067    NA
##                               Conductance (EC)     SiteDepth Fluorescence
## year                                0.01215298 -0.1418250112   0.46254442
## month                               0.60983155 -0.2957748950  -0.27181851
## Depth                                       NA            NA           NA
## Conductance (EC)                    1.00000000 -0.3033956601  -0.24210638
## SiteDepth                          -0.30339566  1.0000000000   0.19608574
## Fluorescence                       -0.24210638  0.1960857351   1.00000000
## Oxygen                             -0.23847836  0.2370914474   0.11712698
## Secchi Depth                        0.64341716 -0.3285001109  -0.12397073
## Temperature                         0.07381793 -0.2519020602   0.01708692
## Turbidity                          -0.65112667  0.4836707915   0.36927259
## Ammonia (Dissolved)                 0.30953542  0.1636438681  -0.17731688
## Chloride (Dissolved)                0.95140894 -0.3712322749  -0.29605114
## Chlorophyll a                      -0.20441283 -0.1163236889   0.24474121
## Kjeldahl Nitrogen (Total)           0.02822701  0.2012696821  -0.01188872
```

```
## Nitrite + Nitrate (Dissolved)       0.35293031  0.0786845736  -0.11912455
## Organic Nitrogen (Dissolved)       -0.08776240  0.2108635537  -0.06367010
## Ortho-phosphate (Dissolved)         0.33838843  0.0637314737  -0.12213747
## Pheophytin a                       -0.17927362 -0.0003336787   0.26381596
## Phosphorus (Total)                  0.01943327  0.2720971557   0.11937508
## Silica (SiO2) (Dissolved)          -0.17923897  0.0853158179   0.14963740
## Solids (Total Dissolved)            0.96180845 -0.3838209617  -0.29855182
## Solids (Total Suspended)           -0.26307541  0.1904093915   0.43432520
## Solids (Volatile Suspended)         0.04894534 -0.1282860299   0.21617569
##                                       Oxygen Secchi Depth Temperature
## year                               0.04842815   0.29783983  0.01692287
## month                             -0.50320596   0.61849790  0.33995748
## Depth                                      NA           NA          NA
## Conductance (EC)                  -0.23847836   0.64341716  0.07381793
## SiteDepth                          0.23709145  -0.32850011 -0.25190206
## Fluorescence                       0.11712698  -0.12397073  0.01708692
## Oxygen                             1.00000000  -0.24742181 -0.91088138
## Secchi Depth                      -0.24742181   1.00000000  0.14105602
## Temperature                       -0.91088138   0.14105602  1.00000000
## Turbidity                          0.29196371  -0.63361177 -0.30693129
## Ammonia (Dissolved)                0.44028117  -0.01777429 -0.61952086
## Chloride (Dissolved)              -0.22842787   0.58413733  0.07940109
## Chlorophyll a                     -0.26912957  -0.15299902  0.50943211
## Kjeldahl Nitrogen (Total)          0.46344982  -0.23612753 -0.58476199
## Nitrite + Nitrate (Dissolved)      0.46413201  -0.03697302 -0.57523818
## Organic Nitrogen (Dissolved)       0.41304520  -0.27422071 -0.50586742
## Ortho-phosphate (Dissolved)       -0.04641109  -0.01033110 -0.12952102
## Pheophytin a                      -0.14415192  -0.37455543  0.35543889
## Phosphorus (Total)                 0.10392177  -0.29906607 -0.21497194
## Silica (SiO2) (Dissolved)          0.38174493  -0.07929122 -0.42171137
## Solids (Total Dissolved)          -0.24054347   0.58810682  0.09120590
## Solids (Total Suspended)          -0.02519261  -0.42756375  0.04387234
## Solids (Volatile Suspended)       -0.14496375  -0.05215145  0.12958269
##                                    Turbidity Ammonia (Dissolved)
## year                               0.06245805         -0.33107906
## month                             -0.58485065          0.05697478
## Depth                                      NA                  NA
## Conductance (EC)                  -0.65112667          0.30953542
## SiteDepth                          0.48367079          0.16364387
## Fluorescence                       0.36927259         -0.17731688
## Oxygen                             0.29196371          0.44028117
## Secchi Depth                      -0.63361177         -0.01777429
## Temperature                       -0.30693129         -0.61952086
## Turbidity                          1.00000000          0.03637011
## Ammonia (Dissolved)                0.03637011          1.00000000
## Chloride (Dissolved)              -0.65814450          0.32227022
## Chlorophyll a                     -0.03817726         -0.41458006
## Kjeldahl Nitrogen (Total)          0.36876259          0.66755788
## Nitrite + Nitrate (Dissolved)      0.02497663          0.72701012
## Organic Nitrogen (Dissolved)       0.36741982          0.45599564
## Ortho-phosphate (Dissolved)        0.09169781          0.51883952
## Pheophytin a                       0.04491162         -0.12619998
## Phosphorus (Total)                 0.47232920          0.42154792
## Silica (SiO2) (Dissolved)          0.32113042          0.21410573
```

```
## Solids (Total Dissolved)      -0.67475449          0.31856726
## Solids (Total Suspended)       0.62598923         -0.14393105
## Solids (Volatile Suspended)    0.24961066         -0.13183728
##                               Chloride (Dissolved) Chlorophyll a
## year                                   -0.06262702    0.11505109
## month                                   0.57799663   -0.15652991
## Depth                                          NA           NA
## Conductance (EC)                        0.95140894   -0.20441283
## SiteDepth                              -0.37123227   -0.11632369
## Fluorescence                           -0.29605114    0.24474121
## Oxygen                                 -0.22842787   -0.26912957
## Secchi Depth                            0.58413733   -0.15299902
## Temperature                             0.07940109    0.50943211
## Turbidity                              -0.65814450   -0.03817726
## Ammonia (Dissolved)                     0.32227022   -0.41458006
## Chloride (Dissolved)                    1.00000000   -0.13302778
## Chlorophyll a                          -0.13302778    1.00000000
## Kjeldahl Nitrogen (Total)               0.06747015   -0.21840369
## Nitrite + Nitrate (Dissolved)           0.40179899   -0.26294221
## Organic Nitrogen (Dissolved)           -0.02535187   -0.22562135
## Ortho-phosphate (Dissolved)             0.36960480   -0.13258503
## Pheophytin a                           -0.11165034    0.59650269
## Phosphorus (Total)                      0.03742482   -0.06892928
## Silica (SiO2) (Dissolved)              -0.19860171   -0.21630196
## Solids (Total Dissolved)                0.98762530   -0.13331125
## Solids (Total Suspended)               -0.30287790    0.12466908
## Solids (Volatile Suspended)             0.04444716    0.10840694
##                               Kjeldahl Nitrogen (Total)
## year                                         -0.12752142
## month                                        -0.32329081
## Depth                                                NA
## Conductance (EC)                              0.02822701
## SiteDepth                                     0.20126968
## Fluorescence                                 -0.01188872
## Oxygen                                        0.46344982
## Secchi Depth                                 -0.23612753
## Temperature                                  -0.58476199
## Turbidity                                     0.36876259
## Ammonia (Dissolved)                           0.66755788
## Chloride (Dissolved)                          0.06747015
## Chlorophyll a                                -0.21840369
## Kjeldahl Nitrogen (Total)                     1.00000000
## Nitrite + Nitrate (Dissolved)                 0.77121588
## Organic Nitrogen (Dissolved)                  0.82990734
## Ortho-phosphate (Dissolved)                   0.67356797
## Pheophytin a                                 -0.07421178
## Phosphorus (Total)                            0.76215063
## Silica (SiO2) (Dissolved)                     0.37973247
## Solids (Total Dissolved)                      0.05768850
## Solids (Total Suspended)                      0.15557967
## Solids (Volatile Suspended)                   0.04753966
##                               Nitrite + Nitrate (Dissolved)
## year                                           -0.18363670
## month                                          -0.13057201
```

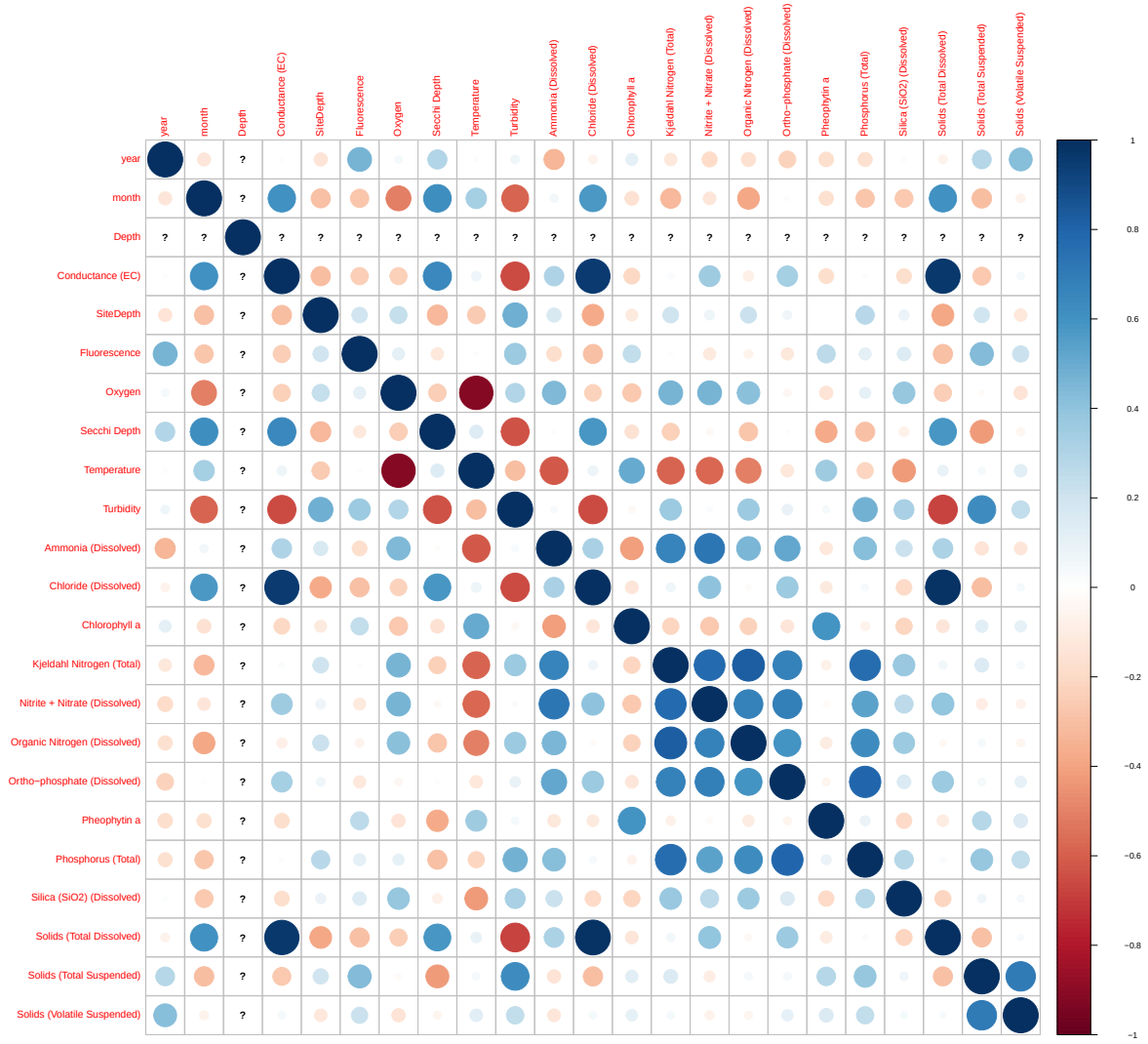
```
## Depth                                                NA
## Conductance (EC)                                0.35293031
## SiteDepth                                       0.07868457
## Fluorescence                                   -0.11912455
## Oxygen                                          0.46413201
## Secchi Depth                                   -0.03697302
## Temperature                                    -0.57523818
## Turbidity                                       0.02497663
## Ammonia (Dissolved)                             0.72701012
## Chloride (Dissolved)                            0.40179899
## Chlorophyll a                                  -0.26294221
## Kjeldahl Nitrogen (Total)                       0.77121588
## Nitrite + Nitrate (Dissolved)                   1.00000000
## Organic Nitrogen (Dissolved)                    0.67137190
## Ortho-phosphate (Dissolved)                     0.68224731
## Pheophytin a                                   -0.02973912
## Phosphorus (Total)                              0.53843595
## Silica (SiO2) (Dissolved)                       0.26832926
## Solids (Total Dissolved)                        0.39296010
## Solids (Total Suspended)                       -0.09871484
## Solids (Volatile Suspended)                    -0.06986276
##                               Organic Nitrogen (Dissolved)
## year                                          -0.16432760
## month                                         -0.38166794
## Depth                                                 NA
## Conductance (EC)                              -0.08776240
## SiteDepth                                      0.21086355
## Fluorescence                                  -0.06367010
## Oxygen                                         0.41304520
## Secchi Depth                                  -0.27422071
## Temperature                                   -0.50586742
## Turbidity                                      0.36741982
## Ammonia (Dissolved)                            0.45599564
## Chloride (Dissolved)                          -0.02535187
## Chlorophyll a                                 -0.22562135
## Kjeldahl Nitrogen (Total)                      0.82990734
## Nitrite + Nitrate (Dissolved)                  0.67137190
## Organic Nitrogen (Dissolved)                   1.00000000
## Ortho-phosphate (Dissolved)                    0.59087536
## Pheophytin a                                  -0.10597250
## Phosphorus (Total)                             0.62327335
## Silica (SiO2) (Dissolved)                      0.36059997
## Solids (Total Dissolved)                      -0.03899296
## Solids (Total Suspended)                       0.04858586
## Solids (Volatile Suspended)                   -0.05371454
##                               Ortho-phosphate (Dissolved)  Pheophytin a
## year                                          -0.22948148 -0.1737619130
## month                                         -0.01974504 -0.1665655462
## Depth                                                 NA            NA
## Conductance (EC)                               0.33838843 -0.1792736207
## SiteDepth                                      0.06373147 -0.0003336787
## Fluorescence                                  -0.12213747  0.2638159617
## Oxygen                                        -0.04641109 -0.1441519242
## Secchi Depth                                  -0.01033110 -0.3745554291
```

```
## Temperature                                -0.12952102  0.3554388911
## Turbidity                                   0.09169781  0.0449116154
## Ammonia (Dissolved)                         0.51883952 -0.1261999772
## Chloride (Dissolved)                        0.36960480 -0.1116503368
## Chlorophyll a                              -0.13258503  0.5965026885
## Kjeldahl Nitrogen (Total)                   0.67356797 -0.0742117782
## Nitrite + Nitrate (Dissolved)               0.68224731 -0.0297391208
## Organic Nitrogen (Dissolved)                0.59087536 -0.1059724954
## Ortho-phosphate (Dissolved)                 1.00000000 -0.0527406807
## Pheophytin a                               -0.05274068  1.0000000000
## Phosphorus (Total)                          0.79670949  0.0831127695
## Silica (SiO2) (Dissolved)                   0.15334267 -0.1940236987
## Solids (Total Dissolved)                    0.36148466 -0.1097172854
## Solids (Total Suspended)                    0.04975924  0.2807364717
## Solids (Volatile Suspended)                 0.10574304  0.1563387699
##                              Phosphorus (Total) Silica (SiO2) (Dissolved)
## year                             -0.16213924                0.01559886
## month                            -0.27188905               -0.26115599
## Depth                                     NA                       NA
## Conductance (EC)                  0.01943327               -0.17923897
## SiteDepth                         0.27209716                0.08531582
## Fluorescence                      0.11937508                0.14963740
## Oxygen                            0.10392177                0.38174493
## Secchi Depth                     -0.29906607               -0.07929122
## Temperature                      -0.21497194               -0.42171137
## Turbidity                         0.47232920                0.32113042
## Ammonia (Dissolved)               0.42154792                0.21410573
## Chloride (Dissolved)              0.03742482               -0.19860171
## Chlorophyll a                    -0.06892928               -0.21630196
## Kjeldahl Nitrogen (Total)         0.76215063                0.37973247
## Nitrite + Nitrate (Dissolved)     0.53843595                0.26832926
## Organic Nitrogen (Dissolved)      0.62327335                0.36059997
## Ortho-phosphate (Dissolved)       0.79670949                0.15334267
## Pheophytin a                      0.08311277               -0.19402370
## Phosphorus (Total)                1.00000000                0.28379366
## Silica (SiO2) (Dissolved)         0.28379366                1.00000000
## Solids (Total Dissolved)          0.02511077               -0.21061706
## Solids (Total Suspended)          0.38683183                0.06012890
## Solids (Volatile Suspended)       0.24486487                0.04038967
##                              Solids (Total Dissolved)
## year                                      -0.06592869
## month                                      0.60347100
## Depth                                             NA
## Conductance (EC)                           0.96180845
## SiteDepth                                 -0.38382096
## Fluorescence                              -0.29855182
## Oxygen                                    -0.24054347
## Secchi Depth                               0.58810682
## Temperature                                0.09120590
## Turbidity                                 -0.67475449
## Ammonia (Dissolved)                        0.31856726
## Chloride (Dissolved)                       0.98762530
## Chlorophyll a                             -0.13331125
## Kjeldahl Nitrogen (Total)                  0.05768850
```

```
## Nitrite + Nitrate (Dissolved)              0.39296010
## Organic Nitrogen (Dissolved)              -0.03899296
## Ortho-phosphate (Dissolved)                0.36148466
## Pheophytin a                              -0.10971729
## Phosphorus (Total)                         0.02511077
## Silica (SiO2) (Dissolved)                 -0.21061706
## Solids (Total Dissolved)                   1.00000000
## Solids (Total Suspended)                  -0.29728010
## Solids (Volatile Suspended)                0.03387005
##                               Solids (Total Suspended)
## year                                       0.28699576
## month                                     -0.30859902
## Depth                                              NA
## Conductance (EC)                          -0.26307541
## SiteDepth                                  0.19040939
## Fluorescence                               0.43432520
## Oxygen                                    -0.02519261
## Secchi Depth                              -0.42756375
## Temperature                                0.04387234
## Turbidity                                  0.62598923
## Ammonia (Dissolved)                       -0.14393105
## Chloride (Dissolved)                      -0.30287790
## Chlorophyll a                              0.12466908
## Kjeldahl Nitrogen (Total)                  0.15557967
## Nitrite + Nitrate (Dissolved)             -0.09871484
## Organic Nitrogen (Dissolved)               0.04858586
## Ortho-phosphate (Dissolved)                0.04975924
## Pheophytin a                               0.28073647
## Phosphorus (Total)                         0.38683183
## Silica (SiO2) (Dissolved)                  0.06012890
## Solids (Total Dissolved)                  -0.29728010
## Solids (Total Suspended)                   1.00000000
## Solids (Volatile Suspended)                0.70641634
##                               Solids (Volatile Suspended)
## year                                           0.42639771
## month                                         -0.06715067
## Depth                                                  NA
## Conductance (EC)                               0.04894534
## SiteDepth                                     -0.12828603
## Fluorescence                                   0.21617569
## Oxygen                                        -0.14496375
## Secchi Depth                                  -0.05215145
## Temperature                                    0.12958269
## Turbidity                                      0.24961066
## Ammonia (Dissolved)                           -0.13183728
## Chloride (Dissolved)                           0.04444716
## Chlorophyll a                                  0.10840694
## Kjeldahl Nitrogen (Total)                      0.04753966
## Nitrite + Nitrate (Dissolved)                 -0.06986276
## Organic Nitrogen (Dissolved)                  -0.05371454
## Ortho-phosphate (Dissolved)                    0.10574304
## Pheophytin a                                   0.15633877
## Phosphorus (Total)                             0.24486487
## Silica (SiO2) (Dissolved)                      0.04038967
```

```
## Solids (Total Dissolved)                    0.03387005
## Solids (Total Suspended)                    0.70641634
## Solids (Volatile Suspended)                 1.00000000
```

```
wqcor.plot <- corrplot(wqcor, method = "circle")
```




```
wqcor.plot
```

```
##                                      year       month Depth
## year                          1.00000000 -0.13975762    NA
## month                        -0.13975762  1.00000000    NA
## Depth                                 NA          NA     1
## Conductance (EC)              0.01215298  0.60983155    NA
## SiteDepth                    -0.14182501 -0.29577490    NA
## Fluorescence                  0.46254442 -0.27181851    NA
```

```
## Oxygen                          0.04842815 -0.50320596    NA
## Secchi Depth                    0.29783983  0.61849790    NA
## Temperature                     0.01692287  0.33995748    NA
## Turbidity                       0.06245805 -0.58485065    NA
## Ammonia (Dissolved)            -0.33107906  0.05697478    NA
## Chloride (Dissolved)           -0.06262702  0.57799663    NA
## Chlorophyll a                   0.11505109 -0.15652991    NA
## Kjeldahl Nitrogen (Total)      -0.12752142 -0.32329081    NA
## Nitrite + Nitrate (Dissolved) -0.18363670 -0.13057201    NA
## Organic Nitrogen (Dissolved)  -0.16432760 -0.38166794    NA
## Ortho-phosphate (Dissolved)   -0.22948148 -0.01974504    NA
## Pheophytin a                  -0.17376191 -0.16656555    NA
## Phosphorus (Total)            -0.16213924 -0.27188905    NA
## Silica (SiO2) (Dissolved)      0.01559886 -0.26115599    NA
## Solids (Total Dissolved)      -0.06592869  0.60347100    NA
## Solids (Total Suspended)       0.28699576 -0.30859902    NA
## Solids (Volatile Suspended)    0.42639771 -0.06715067    NA
##                               Conductance (EC)     SiteDepth Fluorescence
## year                                0.01215298 -0.1418250112   0.46254442
## month                               0.60983155 -0.2957748950  -0.27181851
## Depth                                      NA            NA           NA
## Conductance (EC)                    1.00000000 -0.3033956601  -0.24210638
## SiteDepth                          -0.30339566  1.0000000000   0.19608574
## Fluorescence                       -0.24210638  0.1960857351   1.00000000
## Oxygen                             -0.23847836  0.2370914474   0.11712698
## Secchi Depth                        0.64341716 -0.3285001109  -0.12397073
## Temperature                         0.07381793 -0.2519020602   0.01708692
## Turbidity                          -0.65112667  0.4836707915   0.36927259
## Ammonia (Dissolved)                 0.30953542  0.1636438681  -0.17731688
## Chloride (Dissolved)                0.95140894 -0.3712322749  -0.29605114
## Chlorophyll a                      -0.20441283 -0.1163236889   0.24474121
## Kjeldahl Nitrogen (Total)           0.02822701  0.2012696821  -0.01188872
## Nitrite + Nitrate (Dissolved)       0.35293031  0.0786845736  -0.11912455
## Organic Nitrogen (Dissolved)       -0.08776240  0.2108635537  -0.06367010
## Ortho-phosphate (Dissolved)         0.33838843  0.0637314737  -0.12213747
## Pheophytin a                       -0.17927362 -0.0003336787   0.26381596
## Phosphorus (Total)                  0.01943327  0.2720971557   0.11937508
## Silica (SiO2) (Dissolved)          -0.17923897  0.0853158179   0.14963740
## Solids (Total Dissolved)            0.96180845 -0.3838209617  -0.29855182
## Solids (Total Suspended)           -0.26307541  0.1904093915   0.43432520
## Solids (Volatile Suspended)         0.04894534 -0.1282860299   0.21617569
##                                    Oxygen Secchi Depth Temperature
## year                            0.04842815   0.29783983  0.01692287
## month                          -0.50320596   0.61849790  0.33995748
## Depth                                   NA           NA          NA
## Conductance (EC)               -0.23847836   0.64341716  0.07381793
## SiteDepth                       0.23709145  -0.32850011 -0.25190206
## Fluorescence                    0.11712698  -0.12397073  0.01708692
## Oxygen                          1.00000000  -0.24742181 -0.91088138
## Secchi Depth                   -0.24742181   1.00000000  0.14105602
## Temperature                    -0.91088138   0.14105602  1.00000000
## Turbidity                       0.29196371  -0.63361177 -0.30693129
## Ammonia (Dissolved)             0.44028117  -0.01777429 -0.61952086
## Chloride (Dissolved)           -0.22842787   0.58413733  0.07940109
```

```
## Chlorophyll a                -0.26912957  -0.15299902  0.50943211
## Kjeldahl Nitrogen (Total)     0.46344982  -0.23612753 -0.58476199
## Nitrite + Nitrate (Dissolved) 0.46413201  -0.03697302 -0.57523818
## Organic Nitrogen (Dissolved)  0.41304520  -0.27422071 -0.50586742
## Ortho-phosphate (Dissolved)  -0.04641109  -0.01033110 -0.12952102
## Pheophytin a                 -0.14415192  -0.37455543  0.35543889
## Phosphorus (Total)            0.10392177  -0.29906607 -0.21497194
## Silica (SiO2) (Dissolved)     0.38174493  -0.07929122 -0.42171137
## Solids (Total Dissolved)     -0.24054347   0.58810682  0.09120590
## Solids (Total Suspended)     -0.02519261  -0.42756375  0.04387234
## Solids (Volatile Suspended)  -0.14496375  -0.05215145  0.12958269
##                                Turbidity Ammonia (Dissolved)
## year                           0.06245805         -0.33107906
## month                         -0.58485065          0.05697478
## Depth                                 NA                  NA
## Conductance (EC)              -0.65112667          0.30953542
## SiteDepth                      0.48367079          0.16364387
## Fluorescence                   0.36927259         -0.17731688
## Oxygen                         0.29196371          0.44028117
## Secchi Depth                  -0.63361177         -0.01777429
## Temperature                   -0.30693129         -0.61952086
## Turbidity                      1.00000000          0.03637011
## Ammonia (Dissolved)            0.03637011          1.00000000
## Chloride (Dissolved)          -0.65814450          0.32227022
## Chlorophyll a                 -0.03817726         -0.41458006
## Kjeldahl Nitrogen (Total)      0.36876259          0.66755788
## Nitrite + Nitrate (Dissolved)  0.02497663          0.72701012
## Organic Nitrogen (Dissolved)   0.36741982          0.45599564
## Ortho-phosphate (Dissolved)    0.09169781          0.51883952
## Pheophytin a                   0.04491162         -0.12619998
## Phosphorus (Total)             0.47232920          0.42154792
## Silica (SiO2) (Dissolved)      0.32113042          0.21410573
## Solids (Total Dissolved)      -0.67475449          0.31856726
## Solids (Total Suspended)       0.62598923         -0.14393105
## Solids (Volatile Suspended)    0.24961066         -0.13183728
##                               Chloride (Dissolved) Chlorophyll a
## year                                   -0.06262702    0.11505109
## month                                   0.57799663   -0.15652991
## Depth                                          NA           NA
## Conductance (EC)                        0.95140894   -0.20441283
## SiteDepth                              -0.37123227   -0.11632369
## Fluorescence                           -0.29605114    0.24474121
## Oxygen                                 -0.22842787   -0.26912957
## Secchi Depth                            0.58413733   -0.15299902
## Temperature                             0.07940109    0.50943211
## Turbidity                              -0.65814450   -0.03817726
## Ammonia (Dissolved)                     0.32227022   -0.41458006
## Chloride (Dissolved)                    1.00000000   -0.13302778
## Chlorophyll a                          -0.13302778    1.00000000
## Kjeldahl Nitrogen (Total)               0.06747015   -0.21840369
## Nitrite + Nitrate (Dissolved)           0.40179899   -0.26294221
## Organic Nitrogen (Dissolved)           -0.02535187   -0.22562135
## Ortho-phosphate (Dissolved)             0.36960480   -0.13258503
## Pheophytin a                           -0.11165034    0.59650269
```

```
## Phosphorus (Total)                     0.03742482   -0.06892928
## Silica (SiO2) (Dissolved)             -0.19860171   -0.21630196
## Solids (Total Dissolved)               0.98762530   -0.13331125
## Solids (Total Suspended)              -0.30287790    0.12466908
## Solids (Volatile Suspended)            0.04444716    0.10840694
##                               Kjeldahl Nitrogen (Total)
## year                                      -0.12752142
## month                                     -0.32329081
## Depth                                             NA
## Conductance (EC)                           0.02822701
## SiteDepth                                  0.20126968
## Fluorescence                              -0.01188872
## Oxygen                                     0.46344982
## Secchi Depth                              -0.23612753
## Temperature                               -0.58476199
## Turbidity                                  0.36876259
## Ammonia (Dissolved)                        0.66755788
## Chloride (Dissolved)                       0.06747015
## Chlorophyll a                             -0.21840369
## Kjeldahl Nitrogen (Total)                  1.00000000
## Nitrite + Nitrate (Dissolved)              0.77121588
## Organic Nitrogen (Dissolved)               0.82990734
## Ortho-phosphate (Dissolved)                0.67356797
## Pheophytin a                              -0.07421178
## Phosphorus (Total)                         0.76215063
## Silica (SiO2) (Dissolved)                  0.37973247
## Solids (Total Dissolved)                   0.05768850
## Solids (Total Suspended)                   0.15557967
## Solids (Volatile Suspended)                0.04753966
##                               Nitrite + Nitrate (Dissolved)
## year                                          -0.18363670
## month                                         -0.13057201
## Depth                                                 NA
## Conductance (EC)                               0.35293031
## SiteDepth                                      0.07868457
## Fluorescence                                  -0.11912455
## Oxygen                                         0.46413201
## Secchi Depth                                  -0.03697302
## Temperature                                   -0.57523818
## Turbidity                                      0.02497663
## Ammonia (Dissolved)                            0.72701012
## Chloride (Dissolved)                           0.40179899
## Chlorophyll a                                 -0.26294221
## Kjeldahl Nitrogen (Total)                      0.77121588
## Nitrite + Nitrate (Dissolved)                  1.00000000
## Organic Nitrogen (Dissolved)                   0.67137190
## Ortho-phosphate (Dissolved)                    0.68224731
## Pheophytin a                                  -0.02973912
## Phosphorus (Total)                             0.53843595
## Silica (SiO2) (Dissolved)                      0.26832926
## Solids (Total Dissolved)                       0.39296010
## Solids (Total Suspended)                      -0.09871484
## Solids (Volatile Suspended)                   -0.06986276
##                               Organic Nitrogen (Dissolved)
```

```
## year                                    -0.16432760
## month                                   -0.38166794
## Depth                                           NA
## Conductance (EC)                        -0.08776240
## SiteDepth                                0.21086355
## Fluorescence                            -0.06367010
## Oxygen                                   0.41304520
## Secchi Depth                            -0.27422071
## Temperature                             -0.50586742
## Turbidity                                0.36741982
## Ammonia (Dissolved)                      0.45599564
## Chloride (Dissolved)                    -0.02535187
## Chlorophyll a                           -0.22562135
## Kjeldahl Nitrogen (Total)                0.82990734
## Nitrite + Nitrate (Dissolved)            0.67137190
## Organic Nitrogen (Dissolved)             1.00000000
## Ortho-phosphate (Dissolved)              0.59087536
## Pheophytin a                            -0.10597250
## Phosphorus (Total)                       0.62327335
## Silica (SiO2) (Dissolved)                0.36059997
## Solids (Total Dissolved)                -0.03899296
## Solids (Total Suspended)                 0.04858586
## Solids (Volatile Suspended)             -0.05371454
##                                 Ortho-phosphate (Dissolved)  Pheophytin a
## year                                            -0.22948148 -0.1737619130
## month                                           -0.01974504 -0.1665655462
## Depth                                                   NA            NA
## Conductance (EC)                                 0.33838843 -0.1792736207
## SiteDepth                                        0.06373147 -0.0003336787
## Fluorescence                                    -0.12213747  0.2638159617
## Oxygen                                          -0.04641109 -0.1441519242
## Secchi Depth                                    -0.01033110 -0.3745554291
## Temperature                                     -0.12952102  0.3554388911
## Turbidity                                        0.09169781  0.0449116154
## Ammonia (Dissolved)                              0.51883952 -0.1261999772
## Chloride (Dissolved)                             0.36960480 -0.1116503368
## Chlorophyll a                                   -0.13258503  0.5965026885
## Kjeldahl Nitrogen (Total)                        0.67356797 -0.0742117782
## Nitrite + Nitrate (Dissolved)                    0.68224731 -0.0297391208
## Organic Nitrogen (Dissolved)                     0.59087536 -0.1059724954
## Ortho-phosphate (Dissolved)                      1.00000000 -0.0527406807
## Pheophytin a                                    -0.05274068  1.0000000000
## Phosphorus (Total)                               0.79670949  0.0831127695
## Silica (SiO2) (Dissolved)                        0.15334267 -0.1940236987
## Solids (Total Dissolved)                         0.36148466 -0.1097172854
## Solids (Total Suspended)                         0.04975924  0.2807364717
## Solids (Volatile Suspended)                      0.10574304  0.1563387699
##                                 Phosphorus (Total) Silica (SiO2) (Dissolved)
## year                                    -0.16213924                0.01559886
## month                                   -0.27188905               -0.26115599
## Depth                                           NA                       NA
## Conductance (EC)                         0.01943327               -0.17923897
## SiteDepth                                0.27209716                0.08531582
## Fluorescence                             0.11937508                0.14963740
```

```
## Oxygen                                0.10392177              0.38174493
## Secchi Depth                         -0.29906607             -0.07929122
## Temperature                          -0.21497194             -0.42171137
## Turbidity                             0.47232920              0.32113042
## Ammonia (Dissolved)                   0.42154792              0.21410573
## Chloride (Dissolved)                  0.03742482             -0.19860171
## Chlorophyll a                        -0.06892928             -0.21630196
## Kjeldahl Nitrogen (Total)             0.76215063              0.37973247
## Nitrite + Nitrate (Dissolved)         0.53843595              0.26832926
## Organic Nitrogen (Dissolved)          0.62327335              0.36059997
## Ortho-phosphate (Dissolved)           0.79670949              0.15334267
## Pheophytin a                          0.08311277             -0.19402370
## Phosphorus (Total)                    1.00000000              0.28379366
## Silica (SiO2) (Dissolved)             0.28379366              1.00000000
## Solids (Total Dissolved)              0.02511077             -0.21061706
## Solids (Total Suspended)              0.38683183              0.06012890
## Solids (Volatile Suspended)           0.24486487              0.04038967
##                               Solids (Total Dissolved)
## year                                       -0.06592869
## month                                       0.60347100
## Depth                                              NA
## Conductance (EC)                            0.96180845
## SiteDepth                                  -0.38382096
## Fluorescence                               -0.29855182
## Oxygen                                     -0.24054347
## Secchi Depth                                0.58810682
## Temperature                                 0.09120590
## Turbidity                                  -0.67475449
## Ammonia (Dissolved)                         0.31856726
## Chloride (Dissolved)                        0.98762530
## Chlorophyll a                              -0.13331125
## Kjeldahl Nitrogen (Total)                   0.05768850
## Nitrite + Nitrate (Dissolved)               0.39296010
## Organic Nitrogen (Dissolved)               -0.03899296
## Ortho-phosphate (Dissolved)                 0.36148466
## Pheophytin a                               -0.10971729
## Phosphorus (Total)                          0.02511077
## Silica (SiO2) (Dissolved)                  -0.21061706
## Solids (Total Dissolved)                    1.00000000
## Solids (Total Suspended)                   -0.29728010
## Solids (Volatile Suspended)                 0.03387005
##                               Solids (Total Suspended)
## year                                        0.28699576
## month                                      -0.30859902
## Depth                                              NA
## Conductance (EC)                           -0.26307541
## SiteDepth                                   0.19040939
## Fluorescence                                0.43432520
## Oxygen                                     -0.02519261
## Secchi Depth                               -0.42756375
## Temperature                                 0.04387234
## Turbidity                                   0.62598923
## Ammonia (Dissolved)                        -0.14393105
## Chloride (Dissolved)                       -0.30287790
```

```
## Chlorophyll a                                0.12466908
## Kjeldahl Nitrogen (Total)                    0.15557967
## Nitrite + Nitrate (Dissolved)               -0.09871484
## Organic Nitrogen (Dissolved)                 0.04858586
## Ortho-phosphate (Dissolved)                  0.04975924
## Pheophytin a                                 0.28073647
## Phosphorus (Total)                           0.38683183
## Silica (SiO2) (Dissolved)                    0.06012890
## Solids (Total Dissolved)                    -0.29728010
## Solids (Total Suspended)                     1.00000000
## Solids (Volatile Suspended)                  0.70641634
##                              Solids (Volatile Suspended)
## year                                           0.42639771
## month                                         -0.06715067
## Depth                                                  NA
## Conductance (EC)                               0.04894534
## SiteDepth                                     -0.12828603
## Fluorescence                                   0.21617569
## Oxygen                                        -0.14496375
## Secchi Depth                                  -0.05215145
## Temperature                                    0.12958269
## Turbidity                                      0.24961066
## Ammonia (Dissolved)                           -0.13183728
## Chloride (Dissolved)                           0.04444716
## Chlorophyll a                                  0.10840694
## Kjeldahl Nitrogen (Total)                      0.04753966
## Nitrite + Nitrate (Dissolved)                 -0.06986276
## Organic Nitrogen (Dissolved)                  -0.05371454
## Ortho-phosphate (Dissolved)                    0.10574304
## Pheophytin a                                   0.15633877
## Phosphorus (Total)                             0.24486487
## Silica (SiO2) (Dissolved)                      0.04038967
## Solids (Total Dissolved)                       0.03387005
## Solids (Total Suspended)                       0.70641634
## Solids (Volatile Suspended)                    1.00000000
```

```
#These are my vif analyses before i redid the stepwise regression
#vif1 <- vif(lm(`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature + `Kjeldahl Nitrogen
#vif1 #EC and dissolved solids are very high, they are basically

#vif2 <- vif(lm(`Chlorophyll a` ~ year + `Conductance (EC)` + Oxygen + Temperature + `Kjeldahl Nitrogen
#vif2 ##without dissolved solids

#vif3 <- vif(lm(`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +  `Pheophy
#vif3 ##without EC
#they're both pretty similar-- since EC is a product of total dissolved solids I'm going to use the mod

vif4 <- vif(lm(wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +  `Phe
vif4 #temperature is high..
```

```
##                      year                    Oxygen
##                  1.128642                  9.031764
##               Temperature `Kjeldahl Nitrogen (Total)`
##                  12.336114                  1.763009
##             `Pheophytin a`
```

```
##                   1.762082
```

```
vif5 <- vif(lm(wq.q$`Chlorophyll a` ~ year + Oxygen + `Kjeldahl Nitrogen (Total)` +  `Pheophytin a`, da
vif5 #now theyr'e all below 2.. let's see how they compare to each other. I want to leave temp in becau
```

```
##                      year                    Oxygen
##                  1.063692                  1.307058
## `Kjeldahl Nitrogen (Total)`             `Pheophytin a`
##                  1.313089                  1.052680
```

```
vif6 <- vif(lm(wq.q$`Chlorophyll a` ~ Oxygen + Temperature+ `Kjeldahl Nitrogen (Total)` +  `Pheophytin a
vif6 #after looking at linearity I realized I should probably take year out.. since.. it's not linear?
```

```
##                    Oxygen                Temperature
##                  8.423674                  11.626211
## `Kjeldahl Nitrogen (Total)`             `Pheophytin a`
##                  1.761989                  1.622177
```

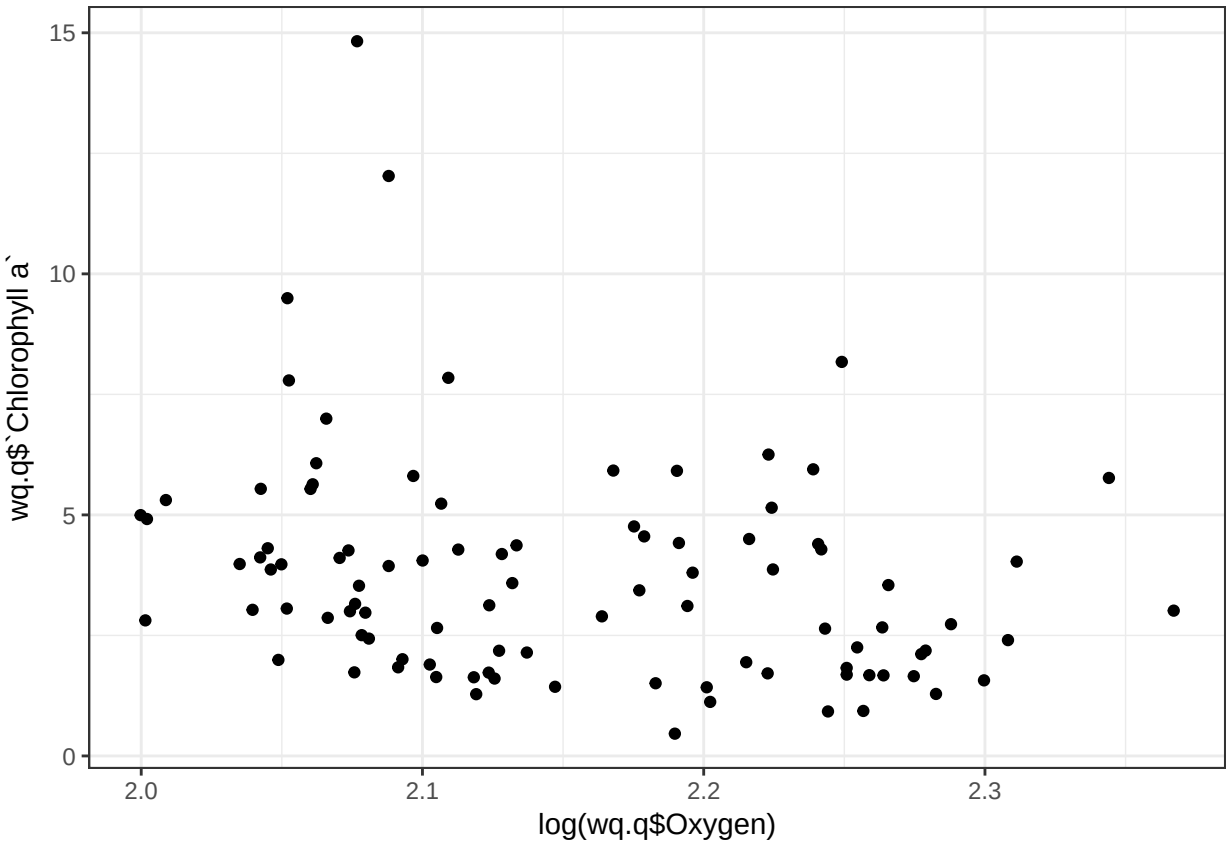
```
mlm1 <- lm(wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +  `Pheophy

mlm2 <- lm(wq.q$`Chlorophyll a` ~ year + Oxygen + `Kjeldahl Nitrogen (Total)` +  `Pheophytin a`, data =

mlm3 <- lm(wq.q$`Chlorophyll a` ~ Oxygen + Temperature+ `Kjeldahl Nitrogen (Total)` +  `Pheophytin a`, d


mlms <- list(temp = mlm1,  notemp = mlm2, noyear = mlm3)
mlms.stats <- mapply(glance, mlms)
colnames(mlms.stats) <- names(mlms)
mlms.stats
```

```
##               temp         notemp       noyear
## r.squared     0.5771286    0.4453311    0.5629654
## adj.r.squared 0.5536357    0.4209501    0.5437551
## sigma         1.53963      1.753596     1.556577
## statistic     24.56613     18.26546     29.30538
## p.value       1.605584e-15 4.799036e-11 1.171101e-15
## df            6            5            5
## logLik        -174.5483    -187.5708    -176.1296
## AIC           363.0965     387.1416     364.2592
## BIC           381.047      402.5277     379.6453
## deviance      213.3413     279.834      220.4867
## df.residual   90           91           91
```

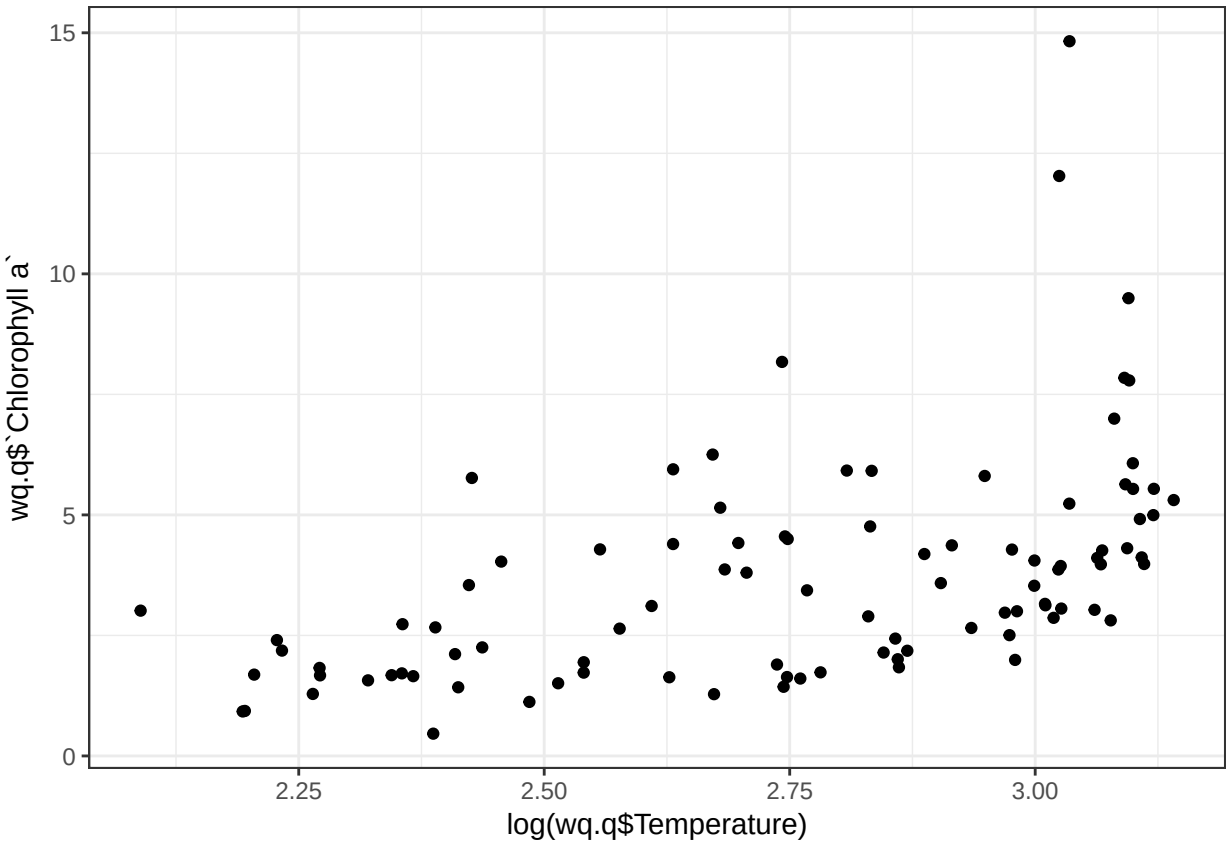
```
#my instincts are validated-- i'm going with the model that includes temperature because it has the hig
#I'm also going to keep year in because.. I think it's okay?
```

Be sure to demonstrate that you have accounted for all assumptions in your regression. Identify any badly fitted observations, discuss whether your residuals are following expected patterns, and discuss whether there are any possible explanations for any poorly modeled observations.

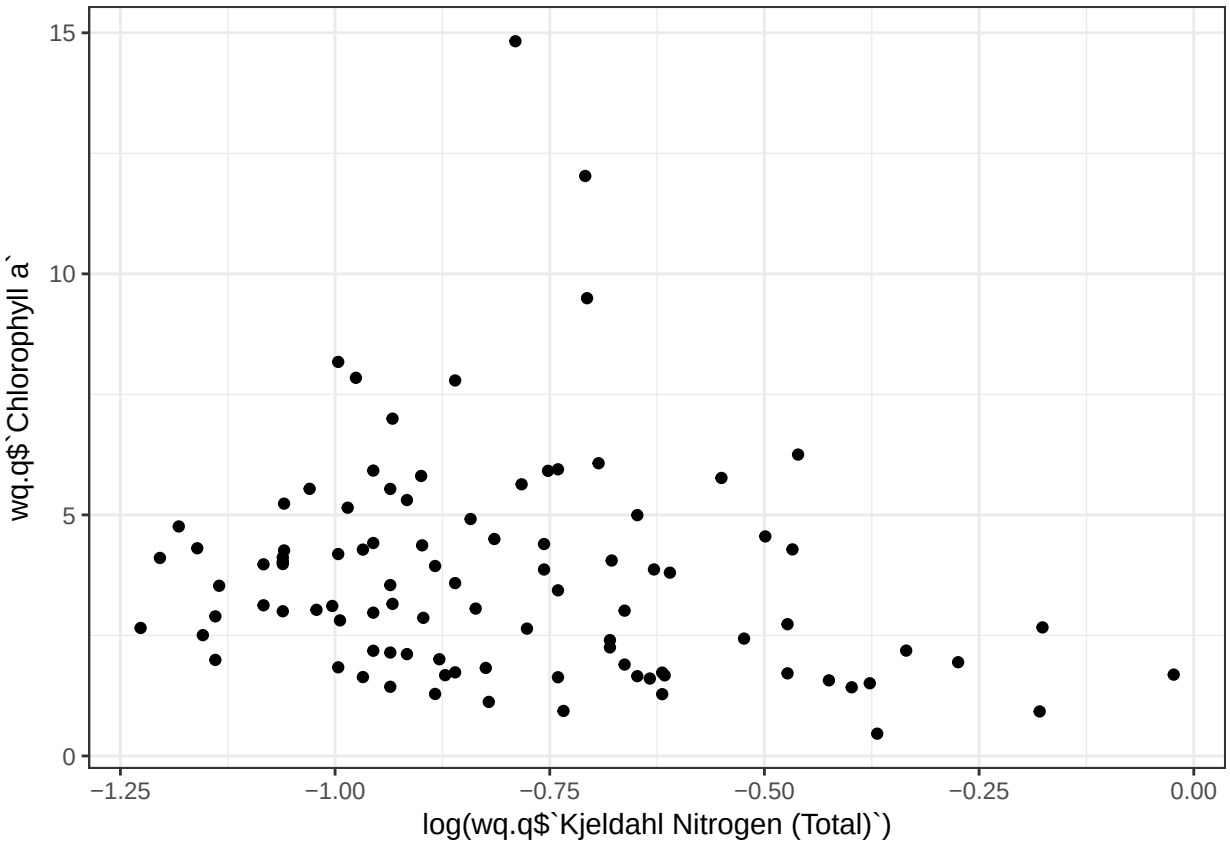
```
lmfinal <- lm(wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +  `Pheo

#plot data for linearity
o2 <- ggplot(aes(x = wq.q$Oxygen, y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()

temp <- ggplot(aes(x = wq.q$Temperature, y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()

n2 <- ggplot(aes(x = wq.q$`Kjeldahl Nitrogen (Total)`, y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()

phea <- ggplot(aes(x = wq.q$`Pheophytin a`, y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()


#um these are all pretty bad so I'm going to log transform the x variable, to correct for linearity

logo2 <- ggplot(aes(x = log(wq.q$Oxygen), y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()
logo2
```



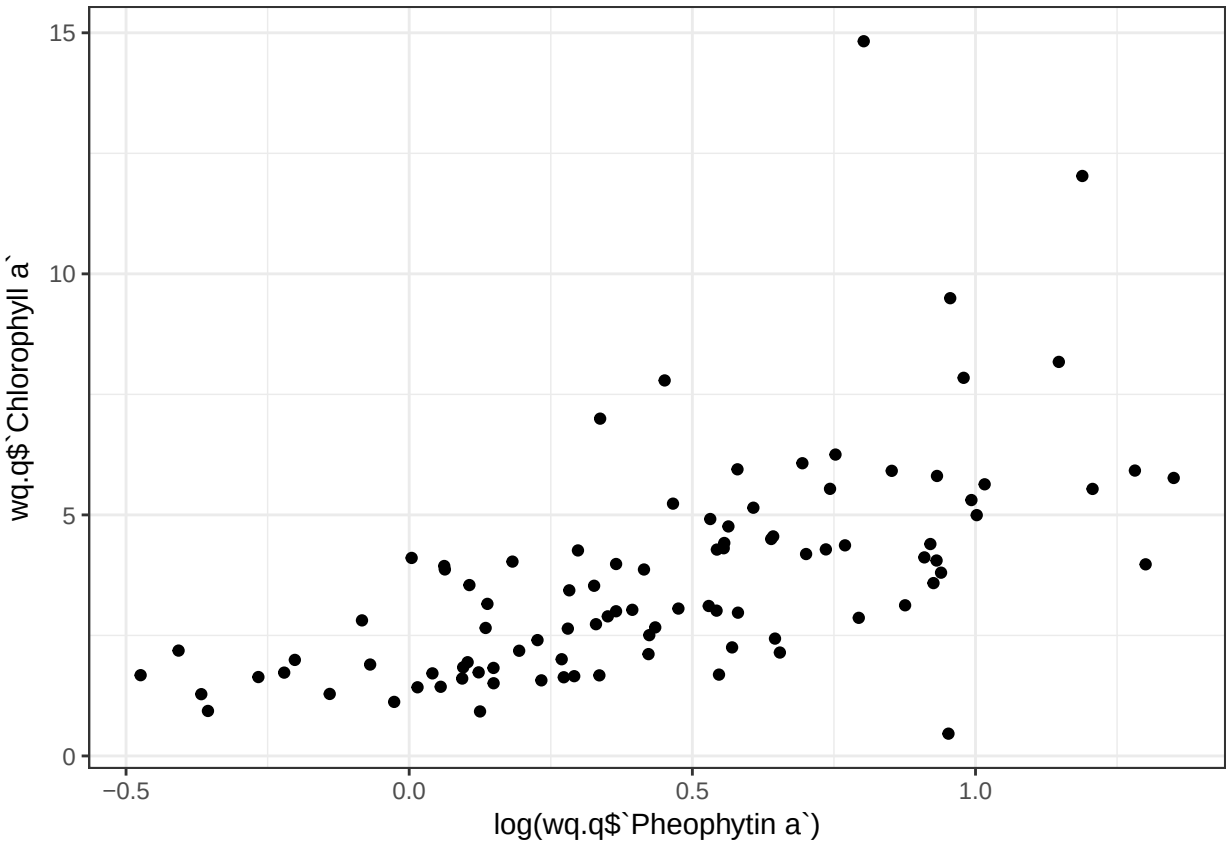

```
logtemp <- ggplot(aes(x = log(wq.q$Temperature), y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()
logtemp
```




```
logn2 <- ggplot(aes(x = log(wq.q$`Kjeldahl Nitrogen (Total)`), y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()
logn2
```

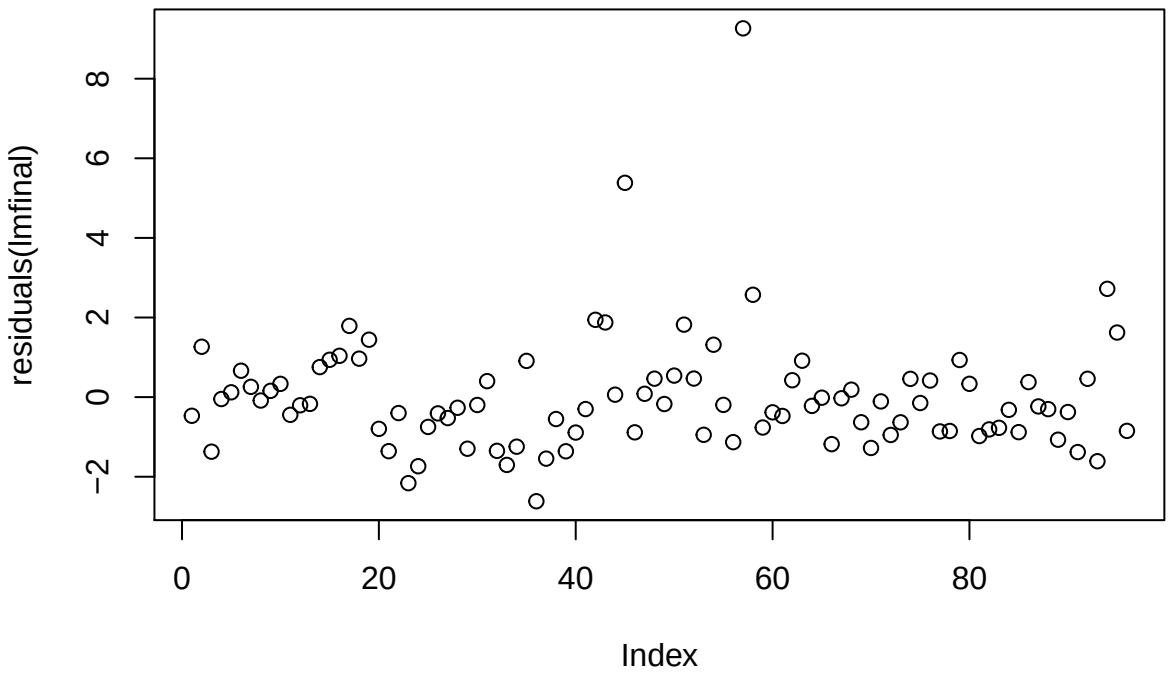



```
logphea <- ggplot(aes(x = log(wq.q$`Pheophytin a`), y = wq.q$`Chlorophyll a`), data = wq.q) +
  theme_bw() +
  geom_point()
logphea
```




```
#truthfully these don't look much better so.. I am going to.. leave it because it is late I'm sorry; id
```

```
plot(residuals(lmfinal)) #Yes! This looks good! except for a few outliers the observations are evenly a
```



Quantify how much variance in mean monthly Chl-a is explained by the variables you selected.

```
lmfinal <- lm(wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature + `Kjeldahl Nitrogen (Total)` +  `Pheo

summary(lmfinal)
```

```
##
## Call:
## lm(formula = wq.q$`Chlorophyll a` ~ year + Oxygen + Temperature +
##     `Kjeldahl Nitrogen (Total)` + `Pheophytin a`, data = wq.q)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.6156 -0.8536 -0.2122  0.4591  9.2646
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 -281.26414  142.26209  -1.977  0.05109 .
## year                           0.12430    0.07159   1.736  0.08595 .
## Oxygen                         2.48487    0.60227   4.126 8.23e-05 ***
## Temperature                    0.66094    0.12479   5.296 8.31e-07 ***
## `Kjeldahl Nitrogen (Total)`    3.07637    1.63026   1.887  0.06238 .
```

```
## `Pheophytin a`                 0.96138    0.29109   3.303  0.00137 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.54 on 90 degrees of freedom
## Multiple R-squared:  0.5771, Adjusted R-squared:  0.5536
## F-statistic: 24.57 on 5 and 90 DF,  p-value: 1.606e-15
```

```
#Adjusted R-squared:  0.5536; model accounts for ~55% of variation in ChlA
```

creating wet/dry season variable

```
#wet season oct-april Xu, L., & Baldocchi, D. D. (2004). Seasonal variation in carbon dioxide exchange
#dry season 6:9

wq.s <- wq.q

wq.s$season <- ifelse(wq.s$month == 6:9,
c("dry"), c("wet"))

wq.s <- wq.s %>%
  select(season, everything())%>%
  select(month, everything()) %>%
 select(year, everything())

wq.s
```

```
## # A tibble: 96 x 24
## # Groups: year [9]
##     year month season Depth `Conductance (E~ SiteDepth Fluorescence Oxygen
##    <dbl> <dbl> <chr>  <dbl>            <dbl>     <dbl>        <dbl>  <dbl>
##  1  2004 10.0  wet     3.00            12951      33.4         1.35   8.01
##  2  2004 11.0  wet     3.00            12791      34.6         1.33   8.32
##  3  2004 12.0  wet     3.00            11360      34.3         1.28   8.93
##  4  2005  1.00 wet     3.00             6480      36.5         1.77   9.43
##  5  2005  2.00 wet     3.00             6788      35.0         1.37   8.87
##  6  2005  3.00 wet     3.00             4981      35.1         2.27   8.84
##  7  2005  4.00 wet     3.00             5753      36.5         2.52   9.17
##  8  2005  5.00 wet     3.00             3545      33.0         2.12   8.44
##  9  2005  6.00 dry     3.00             4873      32.7         1.84   7.98
## 10  2005  7.00 dry     3.00             6708      32.9         1.82   7.71
## # ... with 86 more rows, and 16 more variables: `Secchi Depth` <dbl>,
## #   Temperature <dbl>, Turbidity <dbl>, `Ammonia (Dissolved)` <dbl>,
## #   `Chloride (Dissolved)` <dbl>, `Chlorophyll a` <dbl>, `Kjeldahl
## #   Nitrogen (Total)` <dbl>, `Nitrite + Nitrate (Dissolved)` <dbl>,
## #   `Organic Nitrogen (Dissolved)` <dbl>, `Ortho-phosphate (Dissolved)`
## #   <dbl>, `Pheophytin a` <dbl>, `Phosphorus (Total)` <dbl>, `Silica
## #   (SiO2) (Dissolved)` <dbl>, `Solids (Total Dissolved)` <dbl>, `Solids
## #   (Total Suspended)` <dbl>, `Solids (Volatile Suspended)` <dbl>
```

```
wqcor <- cor(wq.q)
```

```
## Warning in cor(wq.q): the standard deviation is zero
```

```
wqcor
```

```
##                                       year       month Depth
## year                               1.00000000 -0.13975762    NA
## month                             -0.13975762  1.00000000    NA
## Depth                                   NA          NA     1
## Conductance (EC)                   0.01215298  0.60983155    NA
## SiteDepth                         -0.14182501 -0.29577490    NA
## Fluorescence                       0.46254442 -0.27181851    NA
## Oxygen                             0.04842815 -0.50320596    NA
## Secchi Depth                       0.29783983  0.61849790    NA
## Temperature                        0.01692287  0.33995748    NA
## Turbidity                          0.06245805 -0.58485065    NA
## Ammonia (Dissolved)               -0.33107906  0.05697478    NA
## Chloride (Dissolved)              -0.06262702  0.57799663    NA
## Chlorophyll a                      0.11505109 -0.15652991    NA
## Kjeldahl Nitrogen (Total)         -0.12752142 -0.32329081    NA
## Nitrite + Nitrate (Dissolved)     -0.18363670 -0.13057201    NA
## Organic Nitrogen (Dissolved)      -0.16432760 -0.38166794    NA
## Ortho-phosphate (Dissolved)       -0.22948148 -0.01974504    NA
## Pheophytin a                      -0.17376191 -0.16656555    NA
## Phosphorus (Total)                -0.16213924 -0.27188905    NA
## Silica (SiO2) (Dissolved)          0.01559886 -0.26115599    NA
## Solids (Total Dissolved)          -0.06592869  0.60347100    NA
## Solids (Total Suspended)           0.28699576 -0.30859902    NA
## Solids (Volatile Suspended)        0.42639771 -0.06715067    NA
##                                   Conductance (EC)     SiteDepth Fluorescence
## year                                    0.01215298 -0.1418250112   0.46254442
## month                                   0.60983155 -0.2957748950  -0.27181851
## Depth                                          NA            NA           NA
## Conductance (EC)                        1.00000000 -0.3033956601  -0.24210638
## SiteDepth                              -0.30339566  1.0000000000   0.19608574
## Fluorescence                           -0.24210638  0.1960857351   1.00000000
## Oxygen                                 -0.23847836  0.2370914474   0.11712698
## Secchi Depth                            0.64341716 -0.3285001109  -0.12397073
## Temperature                             0.07381793 -0.2519020602   0.01708692
## Turbidity                              -0.65112667  0.4836707915   0.36927259
## Ammonia (Dissolved)                     0.30953542  0.1636438681  -0.17731688
## Chloride (Dissolved)                    0.95140894 -0.3712322749  -0.29605114
## Chlorophyll a                          -0.20441283 -0.1163236889   0.24474121
## Kjeldahl Nitrogen (Total)               0.02822701  0.2012696821  -0.01188872
## Nitrite + Nitrate (Dissolved)           0.35293031  0.0786845736  -0.11912455
## Organic Nitrogen (Dissolved)           -0.08776240  0.2108635537  -0.06367010
## Ortho-phosphate (Dissolved)             0.33838843  0.0637314737  -0.12213747
## Pheophytin a                           -0.17927362 -0.0003336787   0.26381596
## Phosphorus (Total)                      0.01943327  0.2720971557   0.11937508
## Silica (SiO2) (Dissolved)              -0.17923897  0.0853158179   0.14963740
## Solids (Total Dissolved)                0.96180845 -0.3838209617  -0.29855182
## Solids (Total Suspended)               -0.26307541  0.1904093915   0.43432520
## Solids (Volatile Suspended)             0.04894534 -0.1282860299   0.21617569
##                                         Oxygen Secchi Depth Temperature
## year                                 0.04842815   0.29783983  0.01692287
## month                               -0.50320596   0.61849790  0.33995748
## Depth                                        NA           NA          NA
```

```
## Conductance (EC)              -0.23847836   0.64341716  0.07381793
## SiteDepth                      0.23709145  -0.32850011 -0.25190206
## Fluorescence                   0.11712698  -0.12397073  0.01708692
## Oxygen                         1.00000000  -0.24742181 -0.91088138
## Secchi Depth                  -0.24742181   1.00000000  0.14105602
## Temperature                   -0.91088138   0.14105602  1.00000000
## Turbidity                      0.29196371  -0.63361177 -0.30693129
## Ammonia (Dissolved)            0.44028117  -0.01777429 -0.61952086
## Chloride (Dissolved)          -0.22842787   0.58413733  0.07940109
## Chlorophyll a                 -0.26912957  -0.15299902  0.50943211
## Kjeldahl Nitrogen (Total)      0.46344982  -0.23612753 -0.58476199
## Nitrite + Nitrate (Dissolved)  0.46413201  -0.03697302 -0.57523818
## Organic Nitrogen (Dissolved)   0.41304520  -0.27422071 -0.50586742
## Ortho-phosphate (Dissolved)   -0.04641109  -0.01033110 -0.12952102
## Pheophytin a                  -0.14415192  -0.37455543  0.35543889
## Phosphorus (Total)             0.10392177  -0.29906607 -0.21497194
## Silica (SiO2) (Dissolved)      0.38174493  -0.07929122 -0.42171137
## Solids (Total Dissolved)      -0.24054347   0.58810682  0.09120590
## Solids (Total Suspended)      -0.02519261  -0.42756375  0.04387234
## Solids (Volatile Suspended)   -0.14496375  -0.05215145  0.12958269
##                                 Turbidity Ammonia (Dissolved)
## year                            0.06245805         -0.33107906
## month                          -0.58485065          0.05697478
## Depth                                  NA                  NA
## Conductance (EC)               -0.65112667          0.30953542
## SiteDepth                       0.48367079          0.16364387
## Fluorescence                    0.36927259         -0.17731688
## Oxygen                          0.29196371          0.44028117
## Secchi Depth                   -0.63361177         -0.01777429
## Temperature                    -0.30693129         -0.61952086
## Turbidity                       1.00000000          0.03637011
## Ammonia (Dissolved)             0.03637011          1.00000000
## Chloride (Dissolved)           -0.65814450          0.32227022
## Chlorophyll a                  -0.03817726         -0.41458006
## Kjeldahl Nitrogen (Total)       0.36876259          0.66755788
## Nitrite + Nitrate (Dissolved)   0.02497663          0.72701012
## Organic Nitrogen (Dissolved)    0.36741982          0.45599564
## Ortho-phosphate (Dissolved)     0.09169781          0.51883952
## Pheophytin a                    0.04491162         -0.12619998
## Phosphorus (Total)              0.47232920          0.42154792
## Silica (SiO2) (Dissolved)       0.32113042          0.21410573
## Solids (Total Dissolved)       -0.67475449          0.31856726
## Solids (Total Suspended)        0.62598923         -0.14393105
## Solids (Volatile Suspended)     0.24961066         -0.13183728
##                                Chloride (Dissolved) Chlorophyll a
## year                                   -0.06262702    0.11505109
## month                                   0.57799663   -0.15652991
## Depth                                          NA            NA
## Conductance (EC)                        0.95140894   -0.20441283
## SiteDepth                              -0.37123227   -0.11632369
## Fluorescence                           -0.29605114    0.24474121
## Oxygen                                 -0.22842787   -0.26912957
## Secchi Depth                            0.58413733   -0.15299902
## Temperature                             0.07940109    0.50943211
```

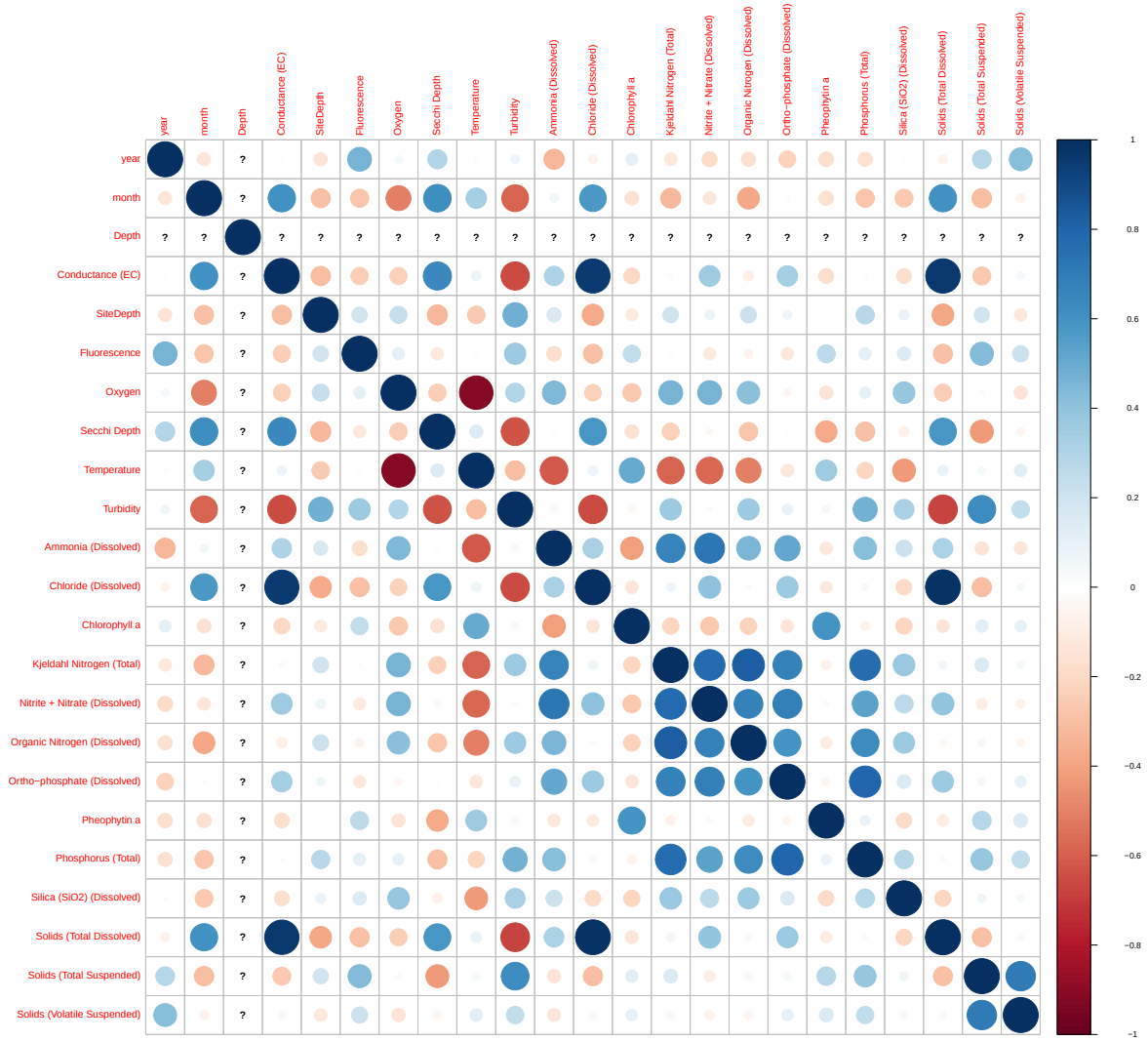
```
## Turbidity                          -0.65814450   -0.03817726
## Ammonia (Dissolved)                 0.32227022   -0.41458006
## Chloride (Dissolved)                1.00000000   -0.13302778
## Chlorophyll a                      -0.13302778    1.00000000
## Kjeldahl Nitrogen (Total)           0.06747015   -0.21840369
## Nitrite + Nitrate (Dissolved)       0.40179899   -0.26294221
## Organic Nitrogen (Dissolved)       -0.02535187   -0.22562135
## Ortho-phosphate (Dissolved)         0.36960480   -0.13258503
## Pheophytin a                       -0.11165034    0.59650269
## Phosphorus (Total)                  0.03742482   -0.06892928
## Silica (SiO2) (Dissolved)          -0.19860171   -0.21630196
## Solids (Total Dissolved)            0.98762530   -0.13331125
## Solids (Total Suspended)           -0.30287790    0.12466908
## Solids (Volatile Suspended)         0.04444716    0.10840694
##                              Kjeldahl Nitrogen (Total)
## year                                      -0.12752142
## month                                     -0.32329081
## Depth                                             NA
## Conductance (EC)                           0.02822701
## SiteDepth                                  0.20126968
## Fluorescence                              -0.01188872
## Oxygen                                     0.46344982
## Secchi Depth                              -0.23612753
## Temperature                               -0.58476199
## Turbidity                                  0.36876259
## Ammonia (Dissolved)                        0.66755788
## Chloride (Dissolved)                       0.06747015
## Chlorophyll a                             -0.21840369
## Kjeldahl Nitrogen (Total)                  1.00000000
## Nitrite + Nitrate (Dissolved)              0.77121588
## Organic Nitrogen (Dissolved)               0.82990734
## Ortho-phosphate (Dissolved)                0.67356797
## Pheophytin a                              -0.07421178
## Phosphorus (Total)                         0.76215063
## Silica (SiO2) (Dissolved)                  0.37973247
## Solids (Total Dissolved)                   0.05768850
## Solids (Total Suspended)                   0.15557967
## Solids (Volatile Suspended)                0.04753966
##                              Nitrite + Nitrate (Dissolved)
## year                                          -0.18363670
## month                                         -0.13057201
## Depth                                                 NA
## Conductance (EC)                               0.35293031
## SiteDepth                                      0.07868457
## Fluorescence                                  -0.11912455
## Oxygen                                         0.46413201
## Secchi Depth                                  -0.03697302
## Temperature                                   -0.57523818
## Turbidity                                      0.02497663
## Ammonia (Dissolved)                            0.72701012
## Chloride (Dissolved)                           0.40179899
## Chlorophyll a                                 -0.26294221
## Kjeldahl Nitrogen (Total)                      0.77121588
## Nitrite + Nitrate (Dissolved)                  1.00000000
```

```
## Organic Nitrogen (Dissolved)                    0.67137190
## Ortho-phosphate (Dissolved)                      0.68224731
## Pheophytin a                                    -0.02973912
## Phosphorus (Total)                               0.53843595
## Silica (SiO2) (Dissolved)                        0.26832926
## Solids (Total Dissolved)                         0.39296010
## Solids (Total Suspended)                        -0.09871484
## Solids (Volatile Suspended)                     -0.06986276
##                               Organic Nitrogen (Dissolved)
## year                                            -0.16432760
## month                                           -0.38166794
## Depth                                                   NA
## Conductance (EC)                                -0.08776240
## SiteDepth                                        0.21086355
## Fluorescence                                    -0.06367010
## Oxygen                                           0.41304520
## Secchi Depth                                    -0.27422071
## Temperature                                     -0.50586742
## Turbidity                                        0.36741982
## Ammonia (Dissolved)                              0.45599564
## Chloride (Dissolved)                            -0.02535187
## Chlorophyll a                                   -0.22562135
## Kjeldahl Nitrogen (Total)                        0.82990734
## Nitrite + Nitrate (Dissolved)                    0.67137190
## Organic Nitrogen (Dissolved)                     1.00000000
## Ortho-phosphate (Dissolved)                      0.59087536
## Pheophytin a                                    -0.10597250
## Phosphorus (Total)                               0.62327335
## Silica (SiO2) (Dissolved)                        0.36059997
## Solids (Total Dissolved)                        -0.03899296
## Solids (Total Suspended)                         0.04858586
## Solids (Volatile Suspended)                     -0.05371454
##                               Ortho-phosphate (Dissolved)  Pheophytin a
## year                                          -0.22948148 -0.1737619130
## month                                         -0.01974504 -0.1665655462
## Depth                                                 NA            NA
## Conductance (EC)                               0.33838843 -0.1792736207
## SiteDepth                                      0.06373147 -0.0003336787
## Fluorescence                                  -0.12213747  0.2638159617
## Oxygen                                        -0.04641109 -0.1441519242
## Secchi Depth                                  -0.01033110 -0.3745554291
## Temperature                                   -0.12952102  0.3554388911
## Turbidity                                      0.09169781  0.0449116154
## Ammonia (Dissolved)                            0.51883952 -0.1261999772
## Chloride (Dissolved)                           0.36960480 -0.1116503368
## Chlorophyll a                                 -0.13258503  0.5965026885
## Kjeldahl Nitrogen (Total)                      0.67356797 -0.0742117782
## Nitrite + Nitrate (Dissolved)                  0.68224731 -0.0297391208
## Organic Nitrogen (Dissolved)                   0.59087536 -0.1059724954
## Ortho-phosphate (Dissolved)                    1.00000000 -0.0527406807
## Pheophytin a                                  -0.05274068  1.0000000000
## Phosphorus (Total)                             0.79670949  0.0831127695
## Silica (SiO2) (Dissolved)                      0.15334267 -0.1940236987
## Solids (Total Dissolved)                       0.36148466 -0.1097172854
```

```
## Solids (Total Suspended)                    0.04975924  0.2807364717
## Solids (Volatile Suspended)                 0.10574304  0.1563387699
##                               Phosphorus (Total) Silica (SiO2) (Dissolved)
## year                                -0.16213924                0.01559886
## month                               -0.27188905               -0.26115599
## Depth                                        NA                       NA
## Conductance (EC)                     0.01943327               -0.17923897
## SiteDepth                            0.27209716                0.08531582
## Fluorescence                         0.11937508                0.14963740
## Oxygen                               0.10392177                0.38174493
## Secchi Depth                        -0.29906607               -0.07929122
## Temperature                         -0.21497194               -0.42171137
## Turbidity                            0.47232920                0.32113042
## Ammonia (Dissolved)                  0.42154792                0.21410573
## Chloride (Dissolved)                 0.03742482               -0.19860171
## Chlorophyll a                       -0.06892928               -0.21630196
## Kjeldahl Nitrogen (Total)            0.76215063                0.37973247
## Nitrite + Nitrate (Dissolved)        0.53843595                0.26832926
## Organic Nitrogen (Dissolved)         0.62327335                0.36059997
## Ortho-phosphate (Dissolved)          0.79670949                0.15334267
## Pheophytin a                         0.08311277               -0.19402370
## Phosphorus (Total)                   1.00000000                0.28379366
## Silica (SiO2) (Dissolved)            0.28379366                1.00000000
## Solids (Total Dissolved)             0.02511077               -0.21061706
## Solids (Total Suspended)             0.38683183                0.06012890
## Solids (Volatile Suspended)          0.24486487                0.04038967
##                               Solids (Total Dissolved)
## year                                       -0.06592869
## month                                       0.60347100
## Depth                                              NA
## Conductance (EC)                            0.96180845
## SiteDepth                                  -0.38382096
## Fluorescence                               -0.29855182
## Oxygen                                     -0.24054347
## Secchi Depth                                0.58810682
## Temperature                                 0.09120590
## Turbidity                                  -0.67475449
## Ammonia (Dissolved)                         0.31856726
## Chloride (Dissolved)                        0.98762530
## Chlorophyll a                              -0.13331125
## Kjeldahl Nitrogen (Total)                   0.05768850
## Nitrite + Nitrate (Dissolved)               0.39296010
## Organic Nitrogen (Dissolved)               -0.03899296
## Ortho-phosphate (Dissolved)                 0.36148466
## Pheophytin a                               -0.10971729
## Phosphorus (Total)                          0.02511077
## Silica (SiO2) (Dissolved)                  -0.21061706
## Solids (Total Dissolved)                    1.00000000
## Solids (Total Suspended)                   -0.29728010
## Solids (Volatile Suspended)                 0.03387005
##                               Solids (Total Suspended)
## year                                        0.28699576
## month                                      -0.30859902
## Depth                                              NA
```

```
## Conductance (EC)                          -0.26307541
## SiteDepth                                  0.19040939
## Fluorescence                               0.43432520
## Oxygen                                    -0.02519261
## Secchi Depth                              -0.42756375
## Temperature                                0.04387234
## Turbidity                                  0.62598923
## Ammonia (Dissolved)                       -0.14393105
## Chloride (Dissolved)                      -0.30287790
## Chlorophyll a                              0.12466908
## Kjeldahl Nitrogen (Total)                  0.15557967
## Nitrite + Nitrate (Dissolved)             -0.09871484
## Organic Nitrogen (Dissolved)               0.04858586
## Ortho-phosphate (Dissolved)                0.04975924
## Pheophytin a                               0.28073647
## Phosphorus (Total)                         0.38683183
## Silica (SiO2) (Dissolved)                  0.06012890
## Solids (Total Dissolved)                  -0.29728010
## Solids (Total Suspended)                   1.00000000
## Solids (Volatile Suspended)                0.70641634
##                              Solids (Volatile Suspended)
## year                                          0.42639771
## month                                        -0.06715067
## Depth                                                NA
## Conductance (EC)                              0.04894534
## SiteDepth                                    -0.12828603
## Fluorescence                                  0.21617569
## Oxygen                                       -0.14496375
## Secchi Depth                                 -0.05215145
## Temperature                                   0.12958269
## Turbidity                                     0.24961066
## Ammonia (Dissolved)                          -0.13183728
## Chloride (Dissolved)                          0.04444716
## Chlorophyll a                                 0.10840694
## Kjeldahl Nitrogen (Total)                     0.04753966
## Nitrite + Nitrate (Dissolved)                -0.06986276
## Organic Nitrogen (Dissolved)                 -0.05371454
## Ortho-phosphate (Dissolved)                   0.10574304
## Pheophytin a                                  0.15633877
## Phosphorus (Total)                            0.24486487
## Silica (SiO2) (Dissolved)                     0.04038967
## Solids (Total Dissolved)                      0.03387005
## Solids (Total Suspended)                      0.70641634
## Solids (Volatile Suspended)                   1.00000000
```

```
wqcor.plot <- corrplot(wqcor, method = "circle")
```




```
wqcor.plot
```

```
##                                 year       month Depth
## year                      1.00000000 -0.13975762    NA
## month                    -0.13975762  1.00000000    NA
## Depth                            NA          NA     1
## Conductance (EC)          0.01215298  0.60983155    NA
## SiteDepth                -0.14182501 -0.29577490    NA
## Fluorescence              0.46254442 -0.27181851    NA
## Oxygen                    0.04842815 -0.50320596    NA
## Secchi Depth              0.29783983  0.61849790    NA
## Temperature               0.01692287  0.33995748    NA
## Turbidity                 0.06245805 -0.58485065    NA
## Ammonia (Dissolved)      -0.33107906  0.05697478    NA
```

```
## Chloride (Dissolved)          -0.06262702  0.57799663    NA
## Chlorophyll a                  0.11505109 -0.15652991    NA
## Kjeldahl Nitrogen (Total)     -0.12752142 -0.32329081    NA
## Nitrite + Nitrate (Dissolved) -0.18363670 -0.13057201    NA
## Organic Nitrogen (Dissolved)  -0.16432760 -0.38166794    NA
## Ortho-phosphate (Dissolved)   -0.22948148 -0.01974504    NA
## Pheophytin a                  -0.17376191 -0.16656555    NA
## Phosphorus (Total)            -0.16213924 -0.27188905    NA
## Silica (SiO2) (Dissolved)      0.01559886 -0.26115599    NA
## Solids (Total Dissolved)      -0.06592869  0.60347100    NA
## Solids (Total Suspended)       0.28699576 -0.30859902    NA
## Solids (Volatile Suspended)    0.42639771 -0.06715067    NA
##                               Conductance (EC)     SiteDepth Fluorescence
## year                                0.01215298 -0.1418250112   0.46254442
## month                               0.60983155 -0.2957748950  -0.27181851
## Depth                                       NA            NA           NA
## Conductance (EC)                    1.00000000 -0.3033956601  -0.24210638
## SiteDepth                          -0.30339566  1.0000000000   0.19608574
## Fluorescence                       -0.24210638  0.1960857351   1.00000000
## Oxygen                             -0.23847836  0.2370914474   0.11712698
## Secchi Depth                        0.64341716 -0.3285001109  -0.12397073
## Temperature                         0.07381793 -0.2519020602   0.01708692
## Turbidity                          -0.65112667  0.4836707915   0.36927259
## Ammonia (Dissolved)                 0.30953542  0.1636438681  -0.17731688
## Chloride (Dissolved)                0.95140894 -0.3712322749  -0.29605114
## Chlorophyll a                      -0.20441283 -0.1163236889   0.24474121
## Kjeldahl Nitrogen (Total)           0.02822701  0.2012696821  -0.01188872
## Nitrite + Nitrate (Dissolved)       0.35293031  0.0786845736  -0.11912455
## Organic Nitrogen (Dissolved)       -0.08776240  0.2108635537  -0.06367010
## Ortho-phosphate (Dissolved)         0.33838843  0.0637314737  -0.12213747
## Pheophytin a                       -0.17927362 -0.0003336787   0.26381596
## Phosphorus (Total)                  0.01943327  0.2720971557   0.11937508
## Silica (SiO2) (Dissolved)          -0.17923897  0.0853158179   0.14963740
## Solids (Total Dissolved)            0.96180845 -0.3838209617  -0.29855182
## Solids (Total Suspended)           -0.26307541  0.1904093915   0.43432520
## Solids (Volatile Suspended)         0.04894534 -0.1282860299   0.21617569
##                                    Oxygen Secchi Depth Temperature
## year                            0.04842815   0.29783983  0.01692287
## month                          -0.50320596   0.61849790  0.33995748
## Depth                                   NA           NA          NA
## Conductance (EC)               -0.23847836   0.64341716  0.07381793
## SiteDepth                       0.23709145  -0.32850011 -0.25190206
## Fluorescence                    0.11712698  -0.12397073  0.01708692
## Oxygen                          1.00000000  -0.24742181 -0.91088138
## Secchi Depth                   -0.24742181   1.00000000  0.14105602
## Temperature                    -0.91088138   0.14105602  1.00000000
## Turbidity                       0.29196371  -0.63361177 -0.30693129
## Ammonia (Dissolved)             0.44028117  -0.01777429 -0.61952086
## Chloride (Dissolved)           -0.22842787   0.58413733  0.07940109
## Chlorophyll a                  -0.26912957  -0.15299902  0.50943211
## Kjeldahl Nitrogen (Total)       0.46344982  -0.23612753 -0.58476199
## Nitrite + Nitrate (Dissolved)   0.46413201  -0.03697302 -0.57523818
## Organic Nitrogen (Dissolved)    0.41304520  -0.27422071 -0.50586742
## Ortho-phosphate (Dissolved)    -0.04641109  -0.01033110 -0.12952102
```

```
## Pheophytin a                  -0.14415192  -0.37455543  0.35543889
## Phosphorus (Total)             0.10392177  -0.29906607 -0.21497194
## Silica (SiO2) (Dissolved)      0.38174493  -0.07929122 -0.42171137
## Solids (Total Dissolved)      -0.24054347   0.58810682  0.09120590
## Solids (Total Suspended)      -0.02519261  -0.42756375  0.04387234
## Solids (Volatile Suspended)   -0.14496375  -0.05215145  0.12958269
##                                 Turbidity Ammonia (Dissolved)
## year                           0.06245805         -0.33107906
## month                         -0.58485065          0.05697478
## Depth                                 NA                  NA
## Conductance (EC)              -0.65112667          0.30953542
## SiteDepth                      0.48367079          0.16364387
## Fluorescence                   0.36927259         -0.17731688
## Oxygen                         0.29196371          0.44028117
## Secchi Depth                  -0.63361177         -0.01777429
## Temperature                   -0.30693129         -0.61952086
## Turbidity                      1.00000000          0.03637011
## Ammonia (Dissolved)            0.03637011          1.00000000
## Chloride (Dissolved)          -0.65814450          0.32227022
## Chlorophyll a                 -0.03817726         -0.41458006
## Kjeldahl Nitrogen (Total)      0.36876259          0.66755788
## Nitrite + Nitrate (Dissolved)  0.02497663          0.72701012
## Organic Nitrogen (Dissolved)   0.36741982          0.45599564
## Ortho-phosphate (Dissolved)    0.09169781          0.51883952
## Pheophytin a                   0.04491162         -0.12619998
## Phosphorus (Total)             0.47232920          0.42154792
## Silica (SiO2) (Dissolved)      0.32113042          0.21410573
## Solids (Total Dissolved)      -0.67475449          0.31856726
## Solids (Total Suspended)       0.62598923         -0.14393105
## Solids (Volatile Suspended)    0.24961066         -0.13183728
##                               Chloride (Dissolved) Chlorophyll a
## year                                  -0.06262702    0.11505109
## month                                  0.57799663   -0.15652991
## Depth                                         NA            NA
## Conductance (EC)                       0.95140894   -0.20441283
## SiteDepth                             -0.37123227   -0.11632369
## Fluorescence                          -0.29605114    0.24474121
## Oxygen                                -0.22842787   -0.26912957
## Secchi Depth                           0.58413733   -0.15299902
## Temperature                            0.07940109    0.50943211
## Turbidity                             -0.65814450   -0.03817726
## Ammonia (Dissolved)                    0.32227022   -0.41458006
## Chloride (Dissolved)                   1.00000000   -0.13302778
## Chlorophyll a                         -0.13302778    1.00000000
## Kjeldahl Nitrogen (Total)              0.06747015   -0.21840369
## Nitrite + Nitrate (Dissolved)          0.40179899   -0.26294221
## Organic Nitrogen (Dissolved)          -0.02535187   -0.22562135
## Ortho-phosphate (Dissolved)            0.36960480   -0.13258503
## Pheophytin a                          -0.11165034    0.59650269
## Phosphorus (Total)                     0.03742482   -0.06892928
## Silica (SiO2) (Dissolved)             -0.19860171   -0.21630196
## Solids (Total Dissolved)               0.98762530   -0.13331125
## Solids (Total Suspended)              -0.30287790    0.12466908
## Solids (Volatile Suspended)            0.04444716    0.10840694
```

```
##                                Kjeldahl Nitrogen (Total)
## year                                         -0.12752142
## month                                        -0.32329081
## Depth                                                NA
## Conductance (EC)                              0.02822701
## SiteDepth                                     0.20126968
## Fluorescence                                 -0.01188872
## Oxygen                                        0.46344982
## Secchi Depth                                 -0.23612753
## Temperature                                  -0.58476199
## Turbidity                                     0.36876259
## Ammonia (Dissolved)                           0.66755788
## Chloride (Dissolved)                          0.06747015
## Chlorophyll a                                -0.21840369
## Kjeldahl Nitrogen (Total)                     1.00000000
## Nitrite + Nitrate (Dissolved)                 0.77121588
## Organic Nitrogen (Dissolved)                  0.82990734
## Ortho-phosphate (Dissolved)                   0.67356797
## Pheophytin a                                 -0.07421178
## Phosphorus (Total)                            0.76215063
## Silica (SiO2) (Dissolved)                     0.37973247
## Solids (Total Dissolved)                      0.05768850
## Solids (Total Suspended)                      0.15557967
## Solids (Volatile Suspended)                   0.04753966
##                                Nitrite + Nitrate (Dissolved)
## year                                            -0.18363670
## month                                           -0.13057201
## Depth                                                    NA
## Conductance (EC)                                 0.35293031
## SiteDepth                                        0.07868457
## Fluorescence                                    -0.11912455
## Oxygen                                           0.46413201
## Secchi Depth                                    -0.03697302
## Temperature                                     -0.57523818
## Turbidity                                        0.02497663
## Ammonia (Dissolved)                              0.72701012
## Chloride (Dissolved)                             0.40179899
## Chlorophyll a                                   -0.26294221
## Kjeldahl Nitrogen (Total)                        0.77121588
## Nitrite + Nitrate (Dissolved)                    1.00000000
## Organic Nitrogen (Dissolved)                     0.67137190
## Ortho-phosphate (Dissolved)                      0.68224731
## Pheophytin a                                    -0.02973912
## Phosphorus (Total)                               0.53843595
## Silica (SiO2) (Dissolved)                        0.26832926
## Solids (Total Dissolved)                         0.39296010
## Solids (Total Suspended)                        -0.09871484
## Solids (Volatile Suspended)                     -0.06986276
##                                Organic Nitrogen (Dissolved)
## year                                           -0.16432760
## month                                          -0.38166794
## Depth                                                  NA
## Conductance (EC)                               -0.08776240
## SiteDepth                                       0.21086355
```

```
## Fluorescence                                -0.06367010
## Oxygen                                       0.41304520
## Secchi Depth                                -0.27422071
## Temperature                                 -0.50586742
## Turbidity                                    0.36741982
## Ammonia (Dissolved)                          0.45599564
## Chloride (Dissolved)                        -0.02535187
## Chlorophyll a                               -0.22562135
## Kjeldahl Nitrogen (Total)                    0.82990734
## Nitrite + Nitrate (Dissolved)                0.67137190
## Organic Nitrogen (Dissolved)                 1.00000000
## Ortho-phosphate (Dissolved)                  0.59087536
## Pheophytin a                                -0.10597250
## Phosphorus (Total)                           0.62327335
## Silica (SiO2) (Dissolved)                    0.36059997
## Solids (Total Dissolved)                    -0.03899296
## Solids (Total Suspended)                     0.04858586
## Solids (Volatile Suspended)                 -0.05371454
##                              Ortho-phosphate (Dissolved)  Pheophytin a
## year                                         -0.22948148 -0.1737619130
## month                                        -0.01974504 -0.1665655462
## Depth                                                NA            NA
## Conductance (EC)                             0.33838843 -0.1792736207
## SiteDepth                                    0.06373147 -0.0003336787
## Fluorescence                                -0.12213747  0.2638159617
## Oxygen                                      -0.04641109 -0.1441519242
## Secchi Depth                                -0.01033110 -0.3745554291
## Temperature                                 -0.12952102  0.3554388911
## Turbidity                                    0.09169781  0.0449116154
## Ammonia (Dissolved)                          0.51883952 -0.1261999772
## Chloride (Dissolved)                         0.36960480 -0.1116503368
## Chlorophyll a                               -0.13258503  0.5965026885
## Kjeldahl Nitrogen (Total)                    0.67356797 -0.0742117782
## Nitrite + Nitrate (Dissolved)                0.68224731 -0.0297391208
## Organic Nitrogen (Dissolved)                 0.59087536 -0.1059724954
## Ortho-phosphate (Dissolved)                  1.00000000 -0.0527406807
## Pheophytin a                                -0.05274068  1.0000000000
## Phosphorus (Total)                           0.79670949  0.0831127695
## Silica (SiO2) (Dissolved)                    0.15334267 -0.1940236987
## Solids (Total Dissolved)                     0.36148466 -0.1097172854
## Solids (Total Suspended)                     0.04975924  0.2807364717
## Solids (Volatile Suspended)                  0.10574304  0.1563387699
##                              Phosphorus (Total) Silica (SiO2) (Dissolved)
## year                                -0.16213924                0.01559886
## month                               -0.27188905               -0.26115599
## Depth                                        NA                       NA
## Conductance (EC)                     0.01943327               -0.17923897
## SiteDepth                            0.27209716                0.08531582
## Fluorescence                         0.11937508                0.14963740
## Oxygen                               0.10392177                0.38174493
## Secchi Depth                        -0.29906607               -0.07929122
## Temperature                         -0.21497194               -0.42171137
## Turbidity                            0.47232920                0.32113042
## Ammonia (Dissolved)                  0.42154792                0.21410573
```

```
## Chloride (Dissolved)                0.03742482             -0.19860171
## Chlorophyll a                      -0.06892928             -0.21630196
## Kjeldahl Nitrogen (Total)           0.76215063              0.37973247
## Nitrite + Nitrate (Dissolved)       0.53843595              0.26832926
## Organic Nitrogen (Dissolved)        0.62327335              0.36059997
## Ortho-phosphate (Dissolved)         0.79670949              0.15334267
## Pheophytin a                        0.08311277             -0.19402370
## Phosphorus (Total)                  1.00000000              0.28379366
## Silica (SiO2) (Dissolved)           0.28379366              1.00000000
## Solids (Total Dissolved)            0.02511077             -0.21061706
## Solids (Total Suspended)            0.38683183              0.06012890
## Solids (Volatile Suspended)         0.24486487              0.04038967
##                               Solids (Total Dissolved)
## year                                       -0.06592869
## month                                       0.60347100
## Depth                                              NA
## Conductance (EC)                            0.96180845
## SiteDepth                                  -0.38382096
## Fluorescence                               -0.29855182
## Oxygen                                     -0.24054347
## Secchi Depth                                0.58810682
## Temperature                                 0.09120590
## Turbidity                                  -0.67475449
## Ammonia (Dissolved)                         0.31856726
## Chloride (Dissolved)                        0.98762530
## Chlorophyll a                              -0.13331125
## Kjeldahl Nitrogen (Total)                   0.05768850
## Nitrite + Nitrate (Dissolved)               0.39296010
## Organic Nitrogen (Dissolved)               -0.03899296
## Ortho-phosphate (Dissolved)                 0.36148466
## Pheophytin a                               -0.10971729
## Phosphorus (Total)                          0.02511077
## Silica (SiO2) (Dissolved)                  -0.21061706
## Solids (Total Dissolved)                    1.00000000
## Solids (Total Suspended)                   -0.29728010
## Solids (Volatile Suspended)                 0.03387005
##                               Solids (Total Suspended)
## year                                        0.28699576
## month                                      -0.30859902
## Depth                                              NA
## Conductance (EC)                           -0.26307541
## SiteDepth                                   0.19040939
## Fluorescence                                0.43432520
## Oxygen                                     -0.02519261
## Secchi Depth                               -0.42756375
## Temperature                                 0.04387234
## Turbidity                                   0.62598923
## Ammonia (Dissolved)                        -0.14393105
## Chloride (Dissolved)                       -0.30287790
## Chlorophyll a                               0.12466908
## Kjeldahl Nitrogen (Total)                   0.15557967
## Nitrite + Nitrate (Dissolved)              -0.09871484
## Organic Nitrogen (Dissolved)                0.04858586
## Ortho-phosphate (Dissolved)                 0.04975924
```

```
## Pheophytin a                                0.28073647
## Phosphorus (Total)                          0.38683183
## Silica (SiO2) (Dissolved)                   0.06012890
## Solids (Total Dissolved)                   -0.29728010
## Solids (Total Suspended)                    1.00000000
## Solids (Volatile Suspended)                 0.70641634
##                              Solids (Volatile Suspended)
## year                                          0.42639771
## month                                        -0.06715067
## Depth                                                NA
## Conductance (EC)                              0.04894534
## SiteDepth                                    -0.12828603
## Fluorescence                                  0.21617569
## Oxygen                                       -0.14496375
## Secchi Depth                                 -0.05215145
## Temperature                                   0.12958269
## Turbidity                                     0.24961066
## Ammonia (Dissolved)                          -0.13183728
## Chloride (Dissolved)                          0.04444716
## Chlorophyll a                                 0.10840694
## Kjeldahl Nitrogen (Total)                     0.04753966
## Nitrite + Nitrate (Dissolved)                -0.06986276
## Organic Nitrogen (Dissolved)                 -0.05371454
## Ortho-phosphate (Dissolved)                   0.10574304
## Pheophytin a                                  0.15633877
## Phosphorus (Total)                            0.24486487
## Silica (SiO2) (Dissolved)                     0.04038967
## Solids (Total Dissolved)                      0.03387005
## Solids (Total Suspended)                      0.70641634
## Solids (Volatile Suspended)                   1.00000000
```

```
##from corrplot above, pheophytin a is the most correlated; 0.59650269; some people mentioned using temp

lm2 <- lm(wq.s$`Chlorophyll a` ~ wq.s$season)
lm2
```

```
##
## Call:
## lm(formula = wq.s$`Chlorophyll a` ~ wq.s$season)
##
## Coefficients:
##    (Intercept)  wq.s$seasonwet
##          5.210          -2.261
```

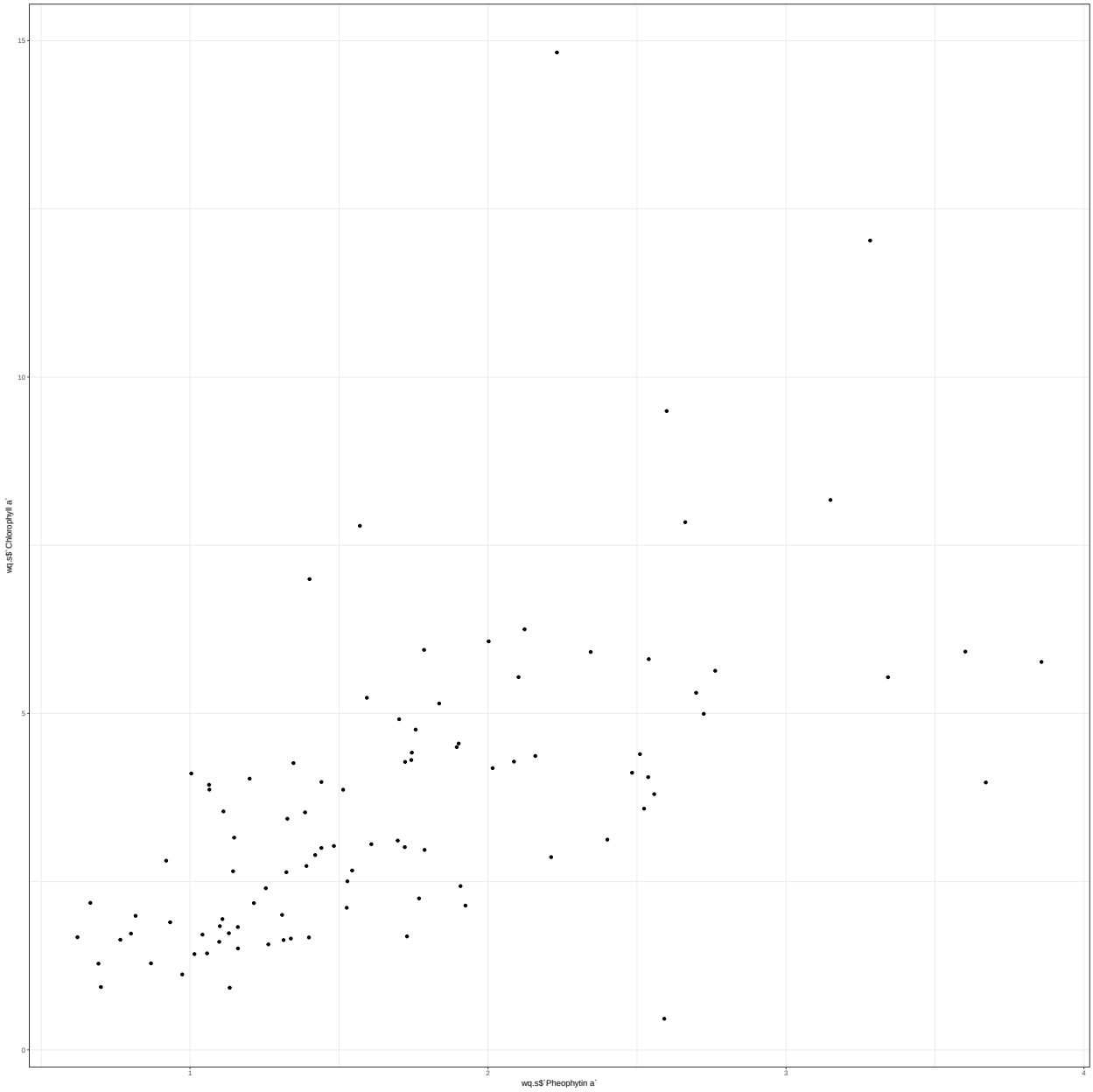
```
lm3 <- lm(wq.s$`Chlorophyll a` ~ wq.s$`Pheophytin a`)
lm3
```

```
##
## Call:
## lm(formula = wq.s$`Chlorophyll a` ~ wq.s$`Pheophytin a`)
##
## Coefficients:
##         (Intercept)  wq.s$`Pheophytin a`
##              0.4458               1.9083
```

```r
lm4 <- lm(wq.s$`Chlorophyll a` ~ wq.s$season + wq.s$`Pheophytin a`)
lm4
```

```
##
## Call:
## lm(formula = wq.s$`Chlorophyll a` ~ wq.s$season + wq.s$`Pheophytin a`)
##
## Coefficients:
##         (Intercept)       wq.s$seasonwet  wq.s$`Pheophytin a`
##               1.988               -1.571                1.618
```

```r
#checking for linearity
pheophytina <- ggplot(aes(x = wq.s$`Pheophytin a`, y = wq.s$`Chlorophyll a`), data = wq.s) +
  theme_bw() +
  geom_point()

pheophytina #pretty good
```



How much of the variation in Chl-a is explained by season? By your most important variable? By both together? Is the combined model better than individual models?

```
require(broom)
lms <- list(season = lm2, pheophytina = lm3, season.pheophytina = lm4)
lms.stats <- mapply(glance, lms)
lms.stats
```

```
##              season       pheophytina  season.pheophytina
## r.squared    0.2161898    0.3558155    0.4519935
```

```
## adj.r.squared 0.2078514    0.3489624    0.4402084
## sigma         2.051043     1.859407     1.724188
## statistic     25.92699     51.92092     38.35301
## p.value       1.818059e-06 1.426426e-10 7.137337e-13
## df            2            2            3
## logLik        -204.169     -194.7523    -186.9908
## AIC           414.338      395.5046     381.9816
## BIC           422.0311     403.1976     392.239
## deviance      395.4372     324.9952     276.4728
## df.residual   94           94           93
```

```
##How much of the variation in Chl-a is explained by season?
# 20% using adjusted rsquared

# By your most important variable?
# 34%

#By both together?
# 44%

#Is the combined model better than individual models?
# Yes, the AIC and BIC are lower for the combined
```

In the parallel regression model (season and your most important variable as predictors), what are the differences in the means between seasons? What is the slope of the linear regression after accounting for season? How does this compare with the slope of the linear regression not considering season?

```
summary(lm4)
```

```
##
## Call:
## lm(formula = wq.s$`Chlorophyll a` ~ wq.s$season + wq.s$`Pheophytin a`)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.1487 -0.8770 -0.2969  0.5487  9.2260
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.9879     0.5936   3.349  0.00117 **
## wq.s$seasonwet       -1.5712     0.3889  -4.040  0.00011 ***
## wq.s$`Pheophytin a`   1.6184     0.2558   6.326 8.71e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.724 on 93 degrees of freedom
## Multiple R-squared:  0.452,  Adjusted R-squared:  0.4402
## F-statistic: 38.35 on 2 and 93 DF,  p-value: 7.137e-13
```

```
#slope with season: -1.5712; slope w/o season: 1.6184; when season is added the slope is negative which
```

Are residuals normally distributed?

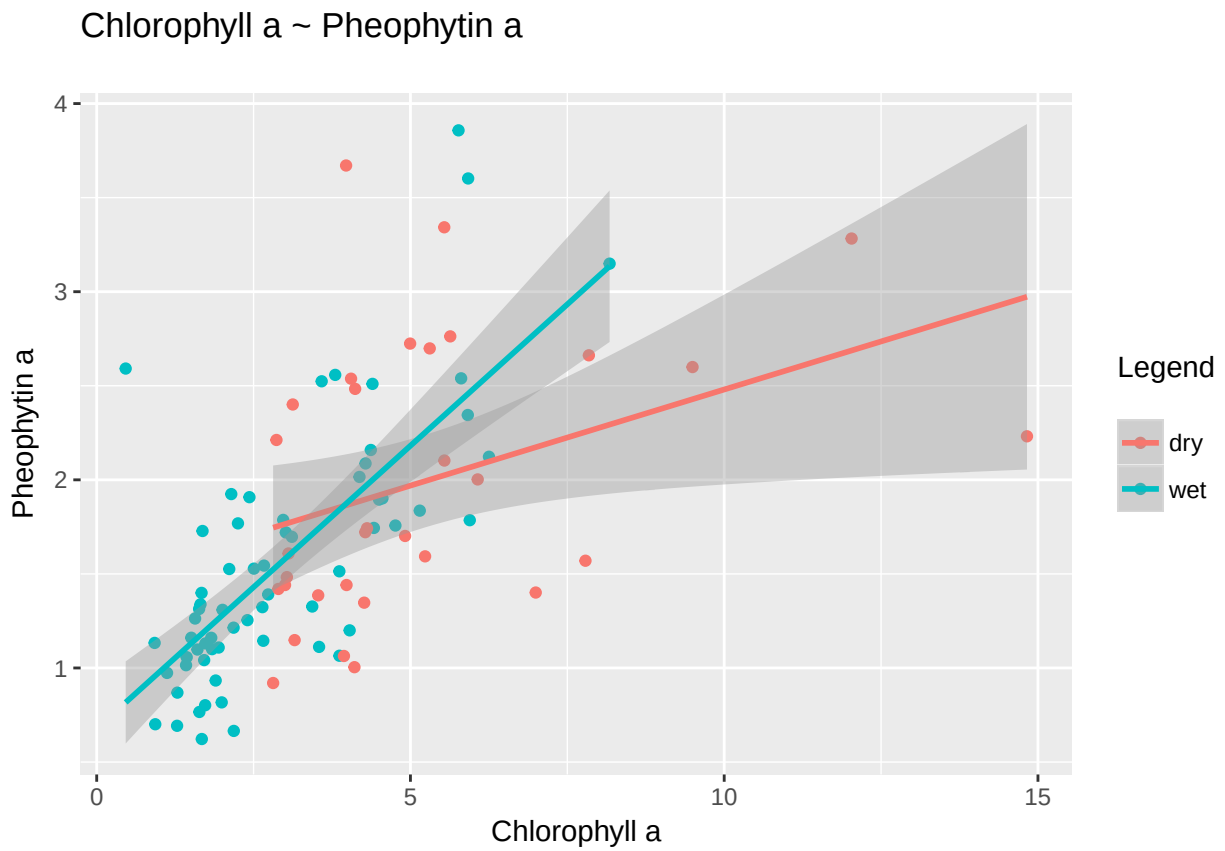
```
stem(residuals(lm4))
```

```
##
##   The decimal point is at the |
##
##   -4 | 10
##   -2 | 770
##   -0 | 995544443310009999998888777766655555544433333222110000
##    0 | 011122233455557789001233557778
##    2 | 467733
##    4 | 7
##    6 |
##    8 | 2
```

```
#pretty normal but there may be some excess kurtosis
```

Plot Chl-a vs your most important variable, with the observations colored by season. Add the paralell regression lines from the combined model in the appropraite colors, and add the univariate regression line.

```
chla <- ggplot(wq.s, aes(x= wq.s$`Chlorophyll a`, y= wq.s$`Pheophytin a`, color=factor(wq.s$season))) +
    geom_point() + labs(title = "Chlorophyll a ~ Pheophytin a\n", x = "Chlorophyll a", y = "Pheophytin a


chla
```




```
#i dont think this is right but I'm not sure what to do
```