

Environ 710 Test 2

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Problem 1

The dataset `bloom` contains information on densities of algae and measurements of sunlight, and nutrients at two categories of water depth, `depthcat` (`s` = shallow, `d` = deep). Algae require warmth, sunlight, and nutrients to grow and reproduce, so they live in the upper 60 to 90 meters (200 to 300 feet) of ocean water.

Hypothesizing that warmer ocean waters resulting from global warming might alter the effects of these factors, researchers sampled algal densities (mg/L) at 20 randomly chosen sites (site: A through T) along the US eastern coast, taking 10 samples at each site.

For each sample, they measured algal density, sunlight, nutrient load (mg/L), and recorded the depth category. The researchers are interested in the effects of sunlight, nutrients and depth on algal density for the entire coast, not particular sites. In this problem, determine what factors drive algal density on the US eastern coast accounting for variation across sampling sites.

#Multiple regression analysis w/ site as random effect and no interaction terms. Not checking for assumptions

```
bloom <- read.csv("~/710 Test 2/Labs/bloom.csv")
lm1 <- lm(algae ~ nutrients + factor(depthcat), data = bloom)
summary(lm1)
```

```
##
## Call:
## lm(formula = algae ~ nutrients + factor(depthcat), data = bloom)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.6191 -1.4218  0.0285  1.1584  3.6776
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    6.583753   0.295196   22.30  <2e-16 ***
## nutrients       0.092228   0.008843   10.43  <2e-16 ***
## factor(depthcat)s 9.383564   0.245459   38.23  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.735 on 197 degrees of freedom
## Multiple R-squared:  0.8898, Adjusted R-squared:  0.8887
## F-statistic: 795.5 on 2 and 197 DF, p-value: < 2.2e-16
```

```
library(car)
```

```
## Loading required package: carData
##
## Attaching package: 'car'
##
## The following object is masked from 'package:openintro':
##
##      densityPlot
```

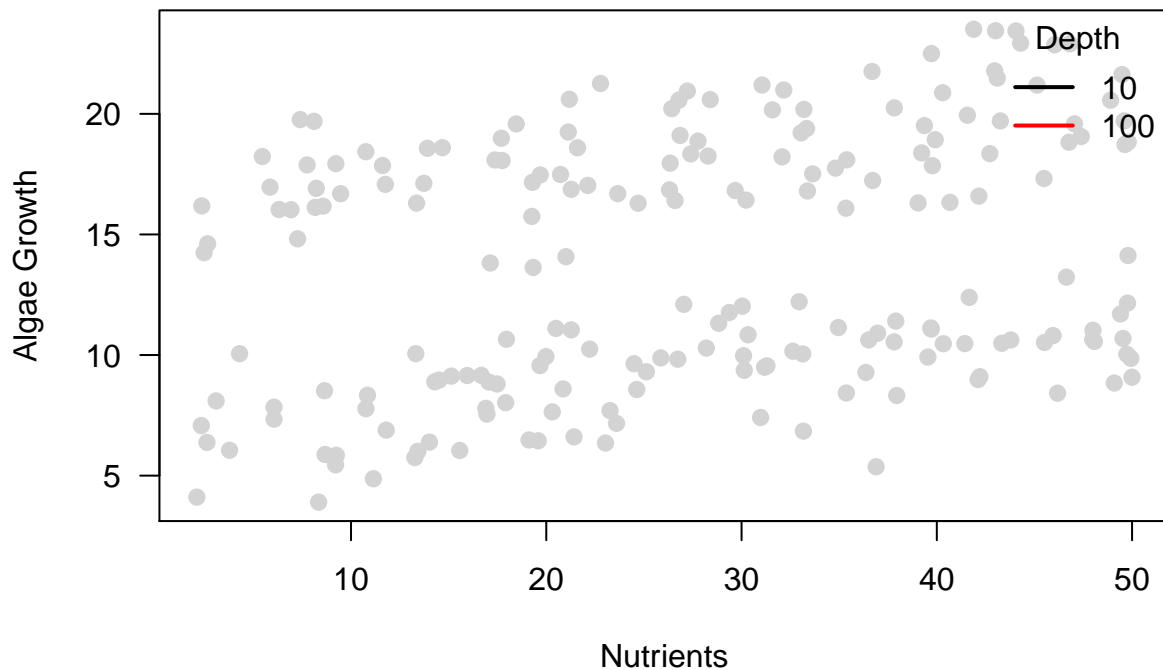
```

vif(lm1)

##          nutrients factor(depthcat)
##          1.000621          1.000621

at.nutrients <- with(bloom, seq(min(nutrients), max(nutrients), 0.5))
d1 <- 10
d2 <- 100
x <- at.nutrients
coef <- coefficients(lm1)
with(bloom, plot(nutrients, algae, las = 1, pch = 16, cex = 1.2,
col = "lightgrey", ylab = "Algae Growth", xlab = "Nutrients"))
curve(coef(lm1)[1] + coef(lm1)[2]*x + coef(lm1)[3]*d1,add=T, lwd = 2)
curve(coef(lm1)[1] + coef(lm1)[2]*x + coef(lm1)[3]*d2,add=T, lwd = 2)
legend("topright", c("10", "100"), col = c("black","red"), lty = 1, lwd = 2,
      title = "Depth", bty="n")

```



```

ele <- read.csv("~/710 Test 2/Labs/ele.csv")
du <- ele$dung/ele$tlen
mod1 <- glm(du ~ dist + elv + factor(park) + dist:elv, family = poisson, data = ele)

```

```

## Warning in dpois(y, mu, log = TRUE): non-integer x = 0.500000
## Warning in dpois(y, mu, log = TRUE): non-integer x = 1.500000
## Warning in dpois(y, mu, log = TRUE): non-integer x = 0.500000
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summary(mod1)

##
## Call:
## glm(formula = du ~ dist + elv + factor(park) + dist:elv, family = poisson,
##      data = ele)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.5192  -1.0115  -0.3841   0.3466   4.9085
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    0.50333    0.47008   1.071   0.2843
## dist           0.05457    0.14188   0.385   0.7005
## elv            3.24184    1.61615   2.006   0.0449 *
## factor(park)out -0.35744    0.14922  -2.395   0.0166 *
## dist:elv       -0.92781    0.49222  -1.885   0.0594 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 212.75  on 99  degrees of freedom
## Residual deviance: 184.76  on 95  degrees of freedom
## AIC: Inf
##
## Number of Fisher Scoring iterations: 5

```

```
mod2 <- glm(du ~ dist + factor(park), family = quasipoisson, data = ele)
summary(mod2)
```

```
##
## Call:
## glm(formula = du ~ dist + factor(park), family = quasipoisson,
##      data = ele)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.6079  -0.9796  -0.4202   0.2545   4.9511
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    1.36664    0.24517   5.574 2.23e-07 ***
## dist          -0.19441    0.07291  -2.667  0.00898 **
## factor(park)out -0.33133    0.22885  -1.448  0.15089
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for quasipoisson family taken to be 2.383643)
##
##      Null deviance: 212.75  on 99  degrees of freedom
## Residual deviance: 188.90  on 97  degrees of freedom
## AIC: NA
##
## Number of Fisher Scoring iterations: 5
```