Getting Started

S. Eanes

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Importing the Data

Data is contained in data/coral_3weighted.csv. This contains all the computed columns, but still needs to be filtered down. We remove N/A U238 samples, include only samples of genus *Acropora* and *Porites*, remove samples older than 10k years, and also remove all samples with a reported calcite value greater than 1. This should result in 700 rows in the data. This final data is stored in `data/final_sample.csv`.

```
coral <- read.csv("~/School/Fossil Coral/data/coral_3weighted.csv")

#omit data with no response
coral <- coral[!is.na(coral$U238),]

#select three largest species
genus_trim <- c("Acropora", "Porites")
#remove coral with age > 10
coral <- coral[which(coral$Genus %in% genus_trim),]  %>% dplyr::filter(Age < 10)
coral <- coral[(coral$Calcite <= 1 | is.na(coral$Calcite)),]

#clean up a nice dataframe, change U238 to correct units
coral.df <- coral %>% mutate(Temperature = Temp, U238=U238*.421) %>%
  select(U238,pH,TAlk,Salinity,Temperature,OmegaA,TCO2,Genus) %>%
  data.frame

nrow(coral.df)
```

```
## [1] 700
```

Basic Modeling

We can quickly reproduce some of the linear models from Patterson et. al.

```
coral.por <- coral.df %>% filter(Genus=="Porites")
coral.acr <- coral.df %>% filter(Genus=="Acropora")
nrow(coral.por)+nrow(coral.acr)==nrow(coral.df)
```

```
## [1] TRUE
```

```
temp.por <- lm(U238 ~ Temperature, data = coral.por)
summary(temp.por)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature, data = coral.por)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.01106 -0.07774 -0.01518  0.06209  0.57831
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.295175   0.109502   20.96   <2e-16 ***
## Temperature -0.043829   0.004061  -10.79   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1512 on 531 degrees of freedom
## Multiple R-squared:  0.1799, Adjusted R-squared:  0.1783
## F-statistic: 116.5 on 1 and 531 DF,  p-value: < 2.2e-16
```

```
temp.acr <- lm(U238 ~ Temperature, data = coral.acr)
summary(temp.acr)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature, data = coral.acr)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.61079 -0.08987 -0.00971  0.07230  1.19998
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.599832   0.241845  14.885  < 2e-16 ***
## Temperature -0.083465   0.009387  -8.892 1.01e-15 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1933 on 165 degrees of freedom
## Multiple R-squared:  0.324,  Adjusted R-squared:  0.3199
## F-statistic: 79.07 on 1 and 165 DF,  p-value: 1.012e-15
```

```
temp <- lm(U238 ~ Temperature, data = coral.df)
summary(temp)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature, data = coral.df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.07219 -0.12604 -0.02158  0.11734  1.40208
##
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.168916   0.118651   26.71   <2e-16 ***
## Temperature -0.074085   0.004447  -16.66   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1985 on 698 degrees of freedom
## Multiple R-squared:  0.2845, Adjusted R-squared:  0.2835
## F-statistic: 277.5 on 1 and 698 DF,  p-value: < 2.2e-16
```

```
tsal.por <- lm(U238 ~ Temperature + Salinity, data = coral.por)
summary(tsal.por)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature + Salinity, data = coral.por)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.02794 -0.07319 -0.00740  0.06790  0.55915
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.985607   0.304875   3.233   0.0013 **
## Temperature -0.034949   0.004431  -7.887 1.78e-14 ***
## Salinity     0.031010   0.006756   4.590 5.54e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1484 on 530 degrees of freedom
## Multiple R-squared:  0.2112, Adjusted R-squared:  0.2082
## F-statistic: 70.96 on 2 and 530 DF,  p-value: < 2.2e-16
```

```
tsal.acr <- lm(U238 ~ Temperature + Salinity, data = coral.acr)
summary(tsal.acr)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature + Salinity, data = coral.acr)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.61315 -0.08973 -0.00209  0.07544  1.19761
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.599483   1.827326   0.875    0.383
## Temperature -0.079857   0.009933  -8.040  1.7e-13 ***
## Salinity     0.053992   0.048889   1.104    0.271
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1932 on 164 degrees of freedom
```

```
## Multiple R-squared:  0.3289, Adjusted R-squared:  0.3208
## F-statistic:  40.2 on 2 and 164 DF,  p-value: 6.227e-15
```

```r
tsal <- lm(U238 ~ Temperature + Salinity, data = coral.df)
summary(tsal)
```

```
##
## Call:
## lm(formula = U238 ~ Temperature + Salinity, data = coral.df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.0956 -0.1205 -0.0183  0.1226  1.3949
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.887094   0.365507   2.427   0.0155 *
## Temperature -0.059156   0.004878 -12.127  < 2e-16 ***
## Salinity     0.054278   0.008251   6.578 9.35e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1928 on 697 degrees of freedom
## Multiple R-squared:  0.3263, Adjusted R-squared:  0.3244
## F-statistic: 168.8 on 2 and 697 DF,  p-value: < 2.2e-16
```