Getting Started

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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 NA U238 samples, include on samples of genus acropora nad 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.

```r
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.

```r
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
```

```r
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
```

```r
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
```

```r
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
```