Homework Assignment 5

Brendan Smith

April 11, 2016

Objective Statement: This homework assignment introduces the development and interaction of raster data. Rasterized data is critical to data analysis in field of land ecology, and in many fields in general. In this assignment, we will be developing a predicive model that will characterize the amount of biomass in the northern California riparian habitats that we've been studying. Through our analysis, we've come to the realization that we do not possess enough data to properly characterize the carbon stocks; however, through the use of a predictive model we can properly inform field scientists which data are assumed to be the best indicator.#read data from file (2 steps)

For Mac: Open Terminal.app and execute `R CMD INSTALL [path to library]`. This will then install the downloaded package from source. An error was encourtered when attempting to install the source package for rgdal with automatic compiling, thus the binary version was downloaded and installed.

```r
# Load libraries
library(rgdal)
```

```
## Loading required package: sp
```

```
## rgdal: version: 1.0-4, (SVN revision 548)
##  Geospatial Data Abstraction Library extensions to R successfully loaded
##  Loaded GDAL runtime: GDAL 1.11.2, released 2015/02/10
##  Path to GDAL shared files: /Library/Frameworks/R.framework/Versions/3.2/Resources/library/rgdal/gdal
##  Loaded PROJ.4 runtime: Rel. 4.9.1, 04 March 2015, [PJ_VERSION: 491]
##  Path to PROJ.4 shared files: /Library/Frameworks/R.framework/Versions/3.2/Resources/library/rgdal/pr
##  Linking to sp version: 1.1-1
```

```r
library(HH)
```

```
## Loading required package: lattice
```

```
## Loading required package: grid
```

```
## Loading required package: latticeExtra
```

```
## Loading required package: RColorBrewer
```

```
## Loading required package: multcomp
```

```
## Loading required package: mvtnorm
```

```
## Loading required package: survival
```

```
## Loading required package: TH.data
```

```
## Loading required package: MASS
```

```
##
## Attaching package: 'TH.data'

## The following object is masked from 'package:MASS':
##
##     geyser

## Loading required package: gridExtra
```

```
library(reshape2)
library(stats)
library(raster)
```

```
## Warning: no function found corresponding to methods exports from 'raster'
## for: 'overlay'

##
## Attaching package: 'raster'

## The following objects are masked from 'package:MASS':
##
##     area, select
```

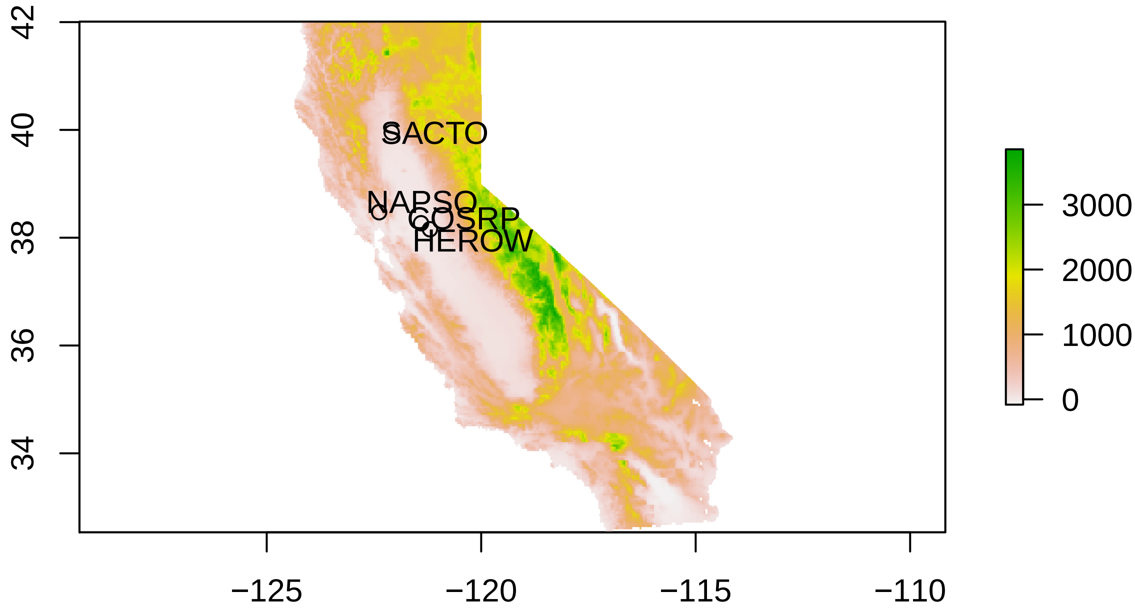
```
# Load Ripdata and place into a dataframe
rip <- read.csv("riparian_cleaned.csv",sep = ",",header = TRUE)
# Add an object that scales the value of height from meters to centimeters
rip$htcm <- rip$Woody_Height_m*100

ProjLoc <- aggregate(cbind(Longitude,Latitude) ~ ProjCode,data=rip, mean)
```

We use the following two commands to read the data from `*.tif` files and then store the data as a projected raster:

```
# Load the DEM
gdal_grid = readGDAL("DEM.tif")
```

```
## DEM.tif has GDAL driver GTiff
## and has 1137 rows and 1233 columns
```

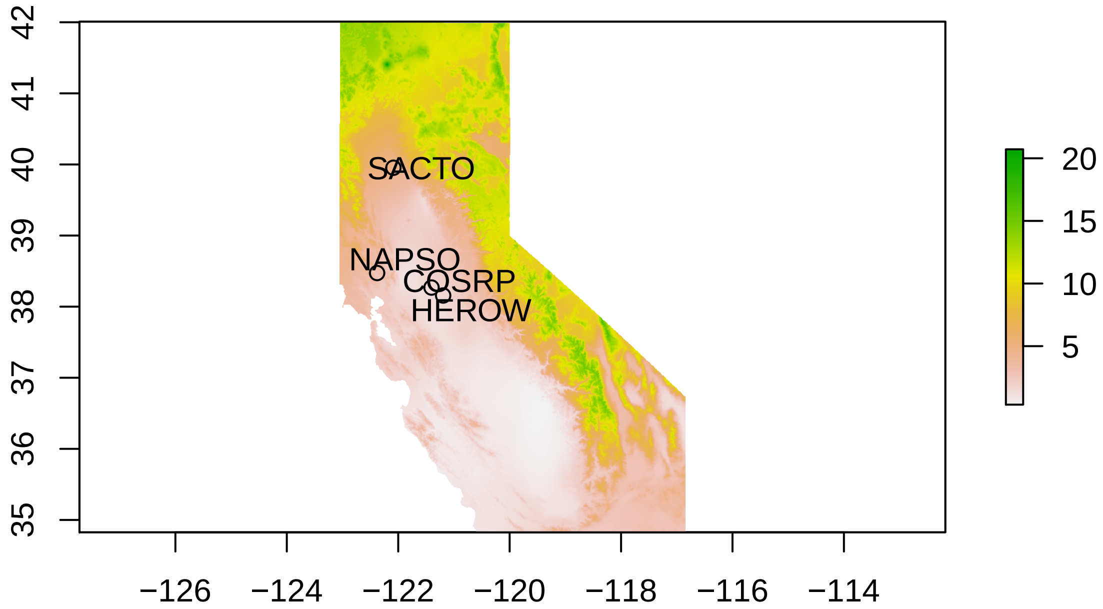
```
dem = raster(gdal_grid) #use data as a projected raster
plot(dem)

# Create a vector to aid in plotting text for ProjLoc$ProjCode
xtext = ProjLoc$Longitude+1
ytext = ProjLoc$Latitude
ytext[1] = ytext[1]+.1
ytext[2] = ytext[2]-.2
ytext[3] = ytext[3]+.2

# Plot the ProjLoc over the DEM
points(ProjLoc$Longitude,ProjLoc$Latitude)
text(xtext,ytext,labels=ProjLoc$ProjCode)
```




```
gdal_grid = readGDAL("precip_8.tif")
```

```
## precip_8.tif has GDAL driver GTiff
## and has 862 rows and 744 columns
```

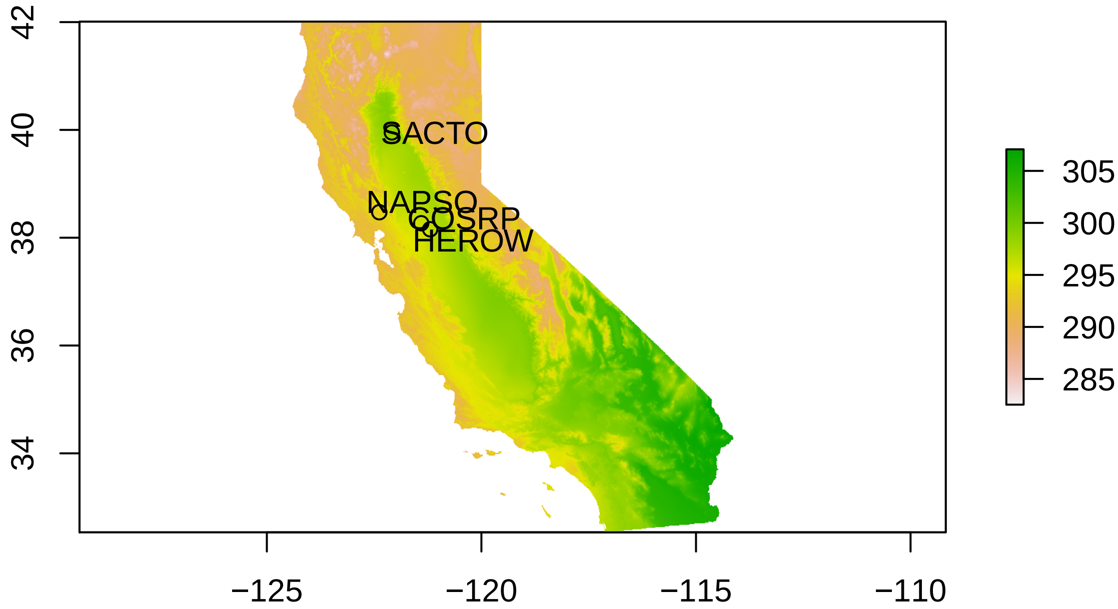
```
precip = raster(gdal_grid) #use data as a projected raster
plot(precip)

# Create a vector to aid in plotting text for ProjLoc$ProjCode
xtext = ProjLoc$Longitude+.5
ytext = ProjLoc$Latitude
ytext[1] = ytext[1]+.1
ytext[2] = ytext[2]-.2
ytext[3] = ytext[3]+.2

# Plot the ProjLoc over the DEM
points(ProjLoc$Longitude,ProjLoc$Latitude)
text(xtext,ytext,labels=ProjLoc$ProjCode)
```




```
gdal_grid = readGDAL("tmean_8.tif")
```

```
## tmean_8.tif has GDAL driver GTiff
## and has 1137 rows and 1233 columns
```

```
tmean = raster(gdal_grid) #use data as a projected raster
plot(tmean)

# Create a vector to aid in plotting text for ProjLoc$ProjCode
xtext = ProjLoc$Longitude+1
ytext = ProjLoc$Latitude
ytext[1] = ytext[1]+.1
ytext[2] = ytext[2]-.2
ytext[3] = ytext[3]+.2

# Plot the ProjLoc over the DEM
points(ProjLoc$Longitude,ProjLoc$Latitude)
text(xtext,ytext,labels=ProjLoc$ProjCode)
```

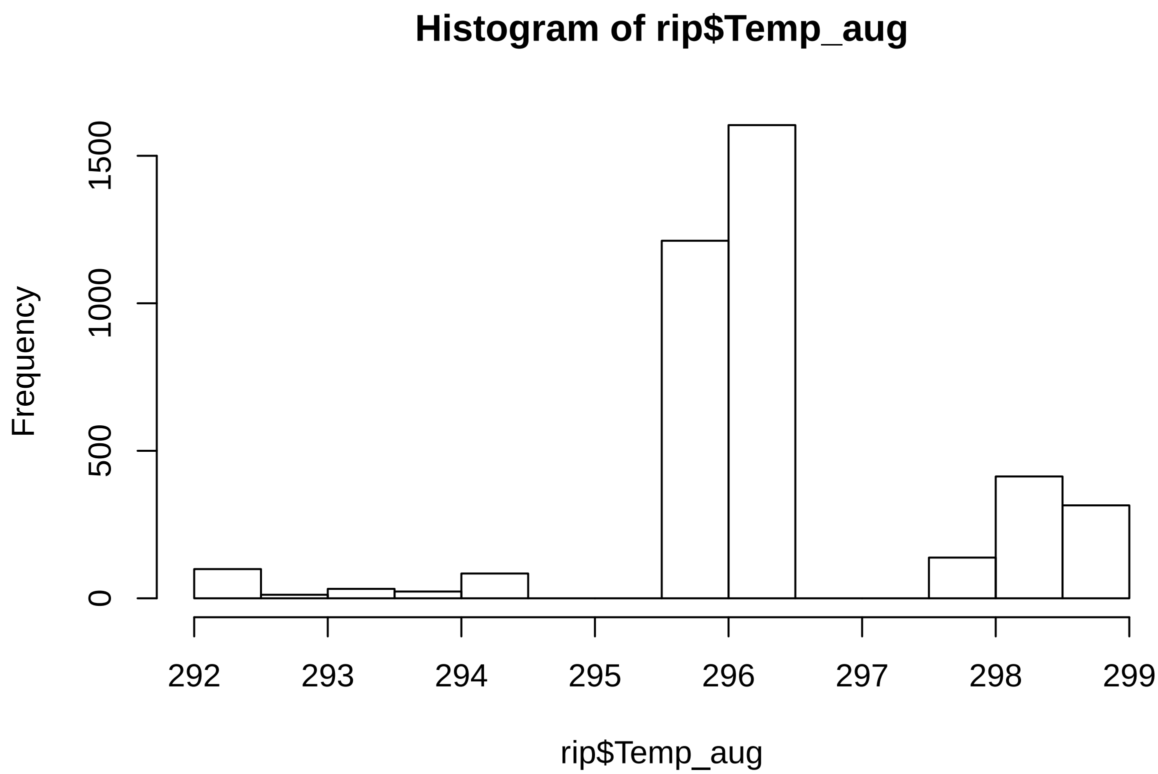



```r
# x,y locations
xy = cbind(rip$Longitude,rip$Latitude)

# extract the values from the dem dataset
evals = extract(dem,xy)

# extract the values from the dem dataset
tvals = extract(tmean,xy)

# extract the values from the dem dataset
pvals = extract(precip,xy)

# Combine all new data into the dataframe
rip$Elevation <- evals
rip$Temp_aug <- tvals
rip$Precp_aug <- pvals
```

```r
# Exploratory data analysis
summary(rip$Temp_aug)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   292.3   296.0   296.0   296.4   296.4   298.9
```

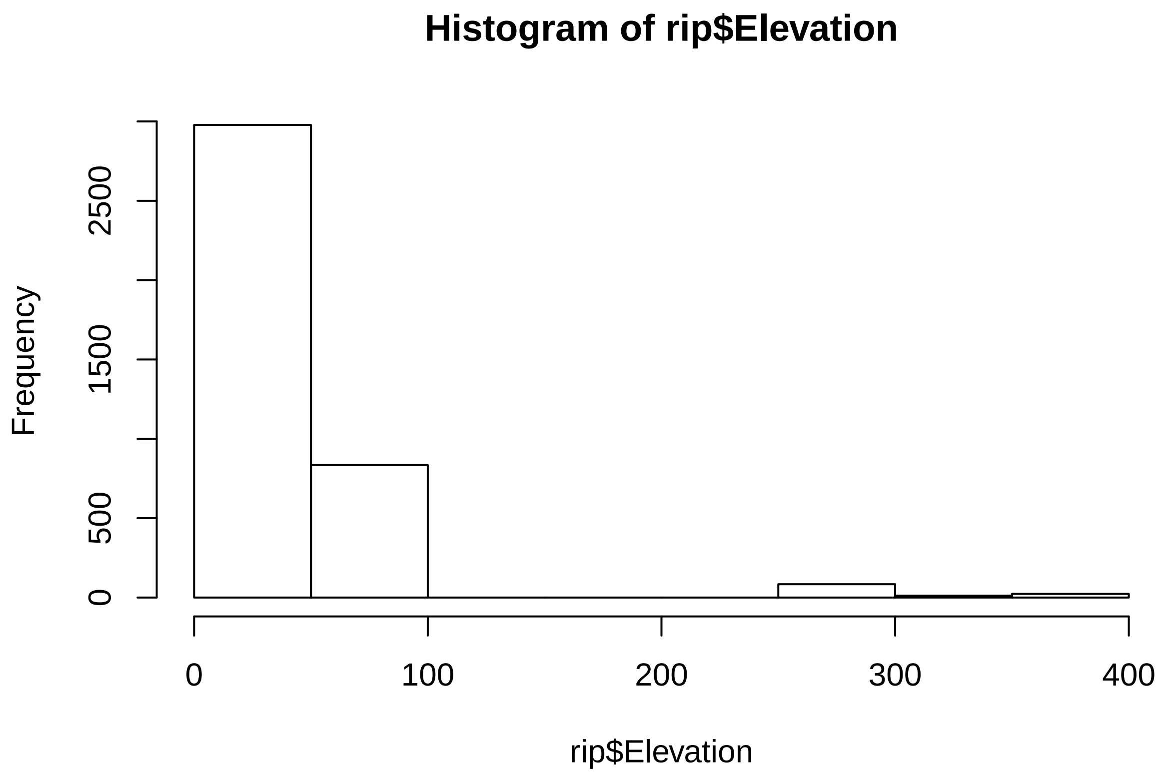
```r
hist(rip$Temp_aug)
```




```r
summary(rip$Elevation)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2.00    5.00    5.00   28.44   49.00  391.00
```

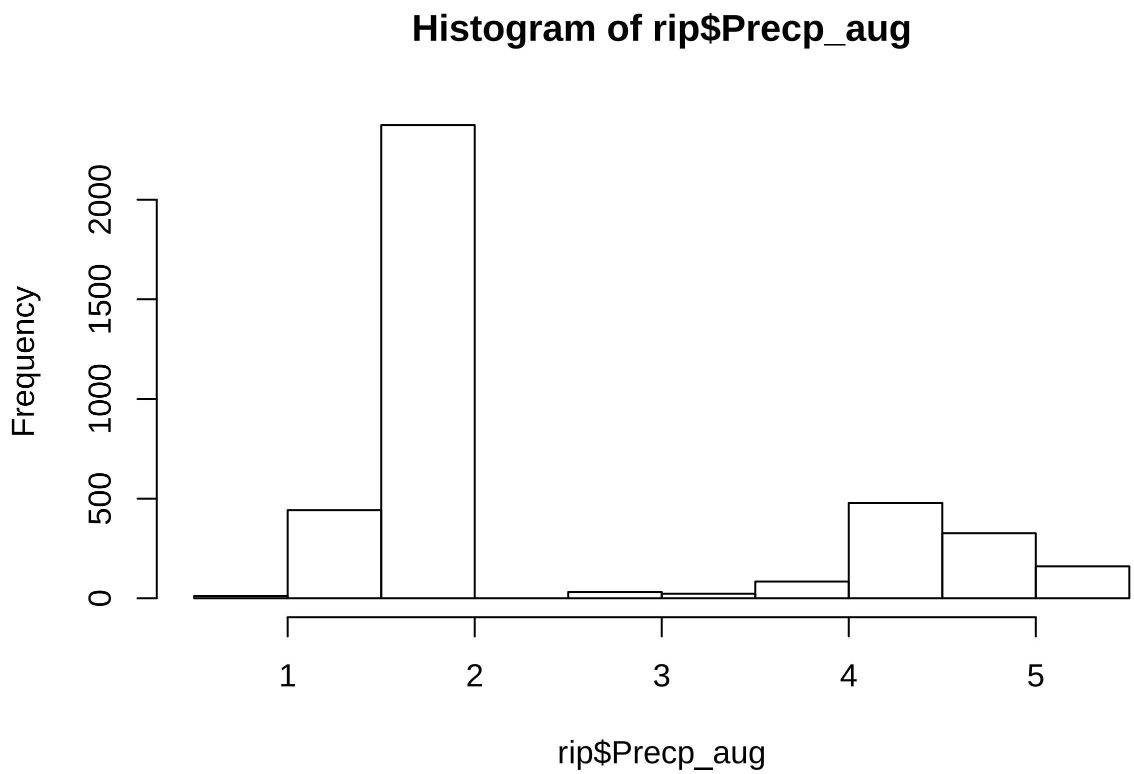
```r
hist(rip$Elevation)
```




```r
summary(rip$Precp_aug)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.797   1.512   1.542   2.348   3.653   5.083
```

```r
hist(rip$Precp_aug)
```




```
# Build Linear models for each predictor
lm.prede <-lm(htcm~Woody_DBH_cm*Genus+Elevation,data=rip)
lm.predp <-lm(htcm~Woody_DBH_cm*Genus+Precp_aug,data=rip)
lm.predt <-lm(htcm~Woody_DBH_cm*Genus+Temp_aug,data=rip)
lm.predl <-lm(htcm~Woody_DBH_cm*Genus+Latitude,data=rip)
lm.base <-lm(htcm~Woody_DBH_cm*Genus,data=rip)

esum <- summary.lm(lm.prede)
psum <- summary.lm(lm.predp) # Best model
tsum <- summary.lm(lm.predt)
lsum <- summary.lm(lm.predl)
bsum <- summary(lm.base)
```

Step 3 - Predicting Carbon

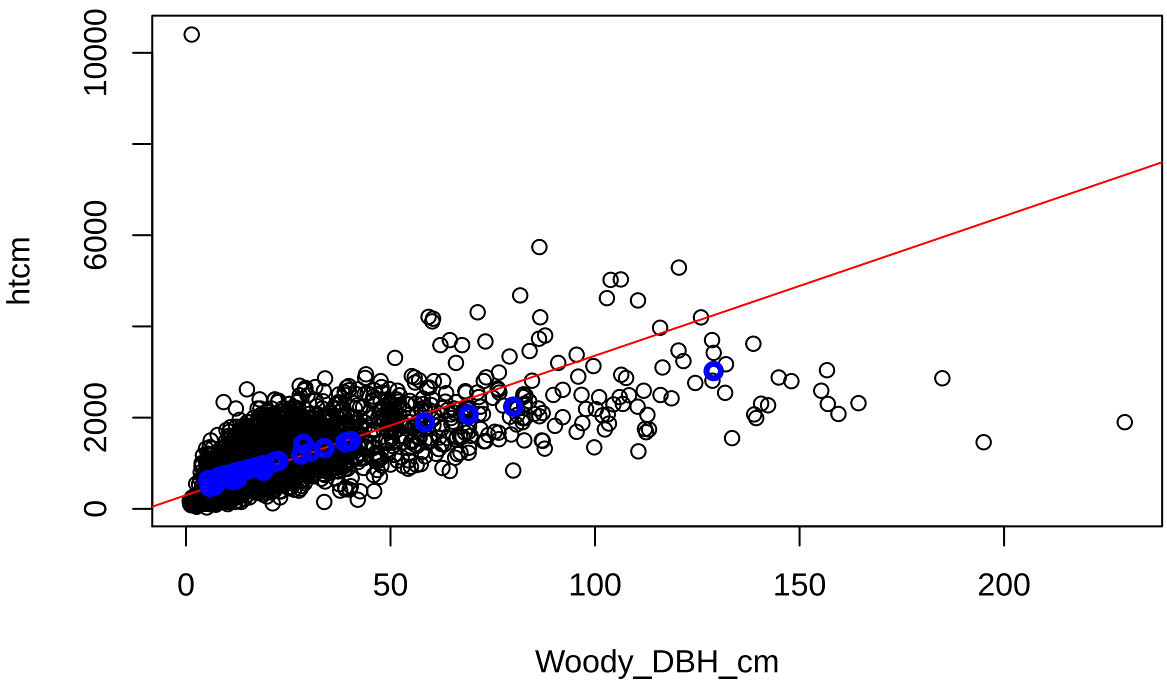
```
# Load new data to compare to predicted model
data <- read.csv("new_data.csv",sep = ",",header = TRUE)

# x,y locations
xy = cbind(data$Longitude,data$Latitude)

# extract the values from the dem dataset
Precp_aug = extract(precip,xy)

# Combine all new data into the dataframe
data$Precp_aug <- Precp_aug

with(rip,plot(Woody_DBH_cm,htcm))
abline(lm.predp,col="red")
```

```
## Warning in abline(lm.predp, col = "red"): only using the first two of 47
## regression coefficients
```

```
#lm1=lm(htcm~Woody_DBH_cm*Genus,data=rip)
lm1.pred.y <-predict(lm.predp,data)
```

```
## Warning in predict.lm(lm.predp, data): prediction from a rank-deficient fit
## may be misleading
```

```
points(data$Woody_DBH_cm,lm1.pred.y,col="blue",lwd=3)
```



One hectare is equavalent to 10,000 squared meters. We extrapolate our calculation from 100 squared meters to estimate the volume of trees at one hectare. This is then multiplied by the density of carbon in order to calculate the Mg of C per hectare.

```
# Calculating the carbon

C = 705*(0.0000334750*data$Woody_DBH_cm^2.33631)*lm1.pred.y^0.74872 # Calculate the Volume for each ind
TV = sum(C) # Calculate the sum of the tree volume
TVpH = (TV/(100))*(10000/1)
MgCpH = (TVpH*.6)*.50/1e6 # The density of wood is about 0.6 g/cm^3 []
```

The estimated Mg of C per hectare for the new site is approximately 44.560

References https://scied.ucar.edu/sites/default/files/images/long-content-page/Carbon%2BStored%2Bin%2BTrees%2Bby%2BSize-Table.pdf