```
library(ISLR)
> source("regboot.pck")
> logiboot
Error: object 'logiboot' not found
> logitboot
function(Form.ob,DF,nboot=10000,alpha=.05)
{
       glm.out0<-glm(Form.ob,DF,family=binomial(link=logit),y=T)
#calculate coefficient
       beta0<-glm.out0$coef
       AIC<-glm.out0$aic
       pred0<-predict(glm.out0,type="response")
       pred1<-predict(glm.out0)
       cov0<-vcov(glm.out0) #calculate covariance matrix for beta0
       betamat<-beta0 #initialize betamat
       distvec<-0      #initialize distance vector
       predmat<-NULL
       for(i in 1:nboot){ #for i in 1 to nboot
              if((i/500)==floor(i/500)){print(i)}
              Iboot<-sample(1:length(pred0),replace=T) #generate random
sample of indeces
              DFboot<-DF[Iboot,]  #choose random X vectors
              glm.boot<-glm(Form.ob,DFboot,family=binomial(link=logit))
#calculate bootstrap beta
              betaboot<-glm.boot$coef
              predb<-predict(glm.boot,DF,type="response")
              predmat<-rbind(predmat,c(predb))
              covboot<-gen.inv1(vcov(glm.boot)) #calculate covariance
matrix for bootstrap beta
              distboot<-t(betaboot-beta0)%*%covboot%*%(betaboot-beta0)
#calculate distance betaboot to beta0
              distvec<-c(distvec,distboot) #add in distance value
              betamat<-rbind(betamat,betaboot) #add in beta boot
       }

qbound<-function(x,alpha1=alpha){quantile(x,c(alpha1/2,1-alpha1/2))}
#create function to calculate both quantiles
       bootindbound<-apply(betamat,2,qbound) #calculate percentile
method individual quantiles for beta
      bootpredbound<-apply(predmat,2,qbound)
       o1<-order(distvec) #create indeces to sort by distance
       b2<-betamat[o1,]    #order beta mat by distance from beta0
       n1<-ceiling((1-alpha)*(nboot+1)) # calculate index 1-alpha *100
percent from beta0
       b2b<-b2[1:n1,] #1-alpha percent closest beta vectors to beta0
       bootsimbound<-apply(b2b,2,range) # outer bounds of the betas
       o1<-order(pred1)

plot(rep(pred1[o1],4),c(glm.out0$y[o1],pred0[o1],bootpredbound[1,o1],bo
otpredbound[2,o1]),type="n",main="Fit,p,and
bounds",xlab="pred",ylab="value")
       points(pred1[o1],glm.out0$y[o1])
       lines(pred1[o1],pred0[o1])
       lines(pred1[o1],bootpredbound[1,o1],col=2)
```

```
      lines(pred1[o1],bootpredbound[2,o1],col=2)

list(alpha=alpha,aic=AIC,coef=beta0,pointwiseCI=bootindbound,simultaneo
usCI=bootsimbound)
}
> dim(Default)
[1] 10000     4
> logitboot(default~.,Default, 500)
Error in gen.inv1(vcov(glm.boot)) : could not find function "gen.inv1"
> logitboot<-edit(logitboot)
> logitboot<-edit(logitboot)
R version change [4.3.2 -> 4.3.3] detected when restoring session;
search path not restored

Connected to your session in progress, last started 2024-Mar-19
02:02:28 UTC (5 minutes ago)
> logitboot<-edit(logitboot)
> logitboot(default~.,Default,500)
Error in gen.inv1(vcov(glm.boot)) : could not find function "gen.inv1"

Timestamp: 30:17 in lecture


> drought <- NOAAGISS[, -c(3:9)]
> View(drought)
> wildfire <- NOAAGISS[,-c(2:6, 8:9)]
> View(wildfire)
> storm <- NOAAGISS[,-c(2:4, 6:9)]
> View(storm)
> alldisaster <- NOAAGISS[,-c(2:8)]
> View(alldisaster)

## model <- glm(Drought.Count ~ Year + delta.temp, data = drought,
family = binomial)
logitboot(Drought.Count~.,Default,10000)
logitboot(Wildfire.Count~.,Default,10000)

## model <- lm(Severe.Storm.Count ~ Year + delta.temp, data = storm)

lmboot(Severe.Storm.Count~.,storm,nboot=10000)
[1] 44  2
Error in gen.inv1(vcovboot) : could not find function "gen.inv1"
In addition: Warning message:
In predict.lm(lm.out0, interval = interval.type, level = 1 - alpha) :
  predictions on current data refer to _future_ responses
```

```
> lmboot(All.Disasters.Count~.,alldisaster,nboot=10000)
[1] 44  2
Error in gen.inv1(vcovboot) : could not find function "gen.inv1"
In addition: Warning message:
In predict.lm(lm.out0, interval = interval.type, level = 1 - alpha) :
  predictions on current data refer to _future_ responses
```

EXPLANATION:

32 is OD DON't NEED 32 PLOTS

So we figured out that Drought.Count and Wildfire.Count only have 0's and 1s as value, so they are binary, and we use logistic regression and run the logitboot model

SevereStorm.Count and All.Disaster.Count have range of values, so we use linear regression and do the lmboot model

Logitboot and LMboot take in models, along with a value at the end that indicates how many times it bootstraps. We should be able to do it 10,000 times, meaning we don't need to write a number at the end, it automatically does 10,000. IF IT DOESN'T WORK: lower to 1000, or 500;
(ex: "logitboot(Drought.Count~.,-delta.temp-Year+I(Year^2),NOAAGISS, 1000)")
(ex:"lmboot(All.Disasters.Count~Year+delta.temp,NOAAGISS,interval.type= "conf",nboot=1000)")

The highlighted part is the model. In the first example, we make the model by comparing Drought.Count column to everything else ("Drought.Count~.") but then remove the delta.temp column and Year column and adding a new I column that is Year^2 ("-delta.temp-Year+I(Year^2)"). This is a model we made up. Different combos of the columns in the dataset will give us a plausible model. We know it is plausible if we have no Zeros in the intervals that come up. BOTH TOP AND BOTTOM NUMBERS SHOULD BE POSITIVE/NEGATIVE, MEANING THERE IS NO ZERO BETWEEN THEM.

Once we have a couple plausible models under each of the 4 categories, we find the best one by looking for the lowest $AIC and $PRESS vales

Logistic , binary → do logitboot model- look at AIC
Linear, → do lmboot - look at PRESS

CODE:

```
> library(ISLR)
```

```
> source("regboot.pck")
> logitboot

# Drought and Wildfire are binary, so we use Logitboot for logistic
regression

# Drought
> logitboot(Drought.Count~.,-delta.temp-Year+I(Year^2),NOAAGISS)
> logitboot(Drought.Count~Year*delta.temp+I(Year^2),NOAAGISS


# Wildfire
>logitboot(Wildfire.Count~.,-delta.temp-Year+I(Year^2)+I(delta.temp^2),
NOAAGISS)
>logitboot(Wildfire.Count~Year*delta.temp+I(Year^2)+I(delta.temp^2),NOA
AGISS)

# Severe Storm

lmboot(Severe.Storm.Count~.,-Year-delta.temp,NOAAGISS,interval.type="co
nf",nboot=1000)

lmboot(Severe.Storm.Count~Year*delta.temp+I(Year^2)+I(delta.temp^2),NOA
AGISS,interval.type="conf",nboot=1000)

# All Disasters
lmboot(All.Disasters.Count~.,-Year-delta.temp,NOAGISS,interval.type="co
nf",nboot=1000)
lmboot(All.Disasters.Count~Year+delta.temp,NOAAGISS,interval.type="conf
",nboot=1000)
```

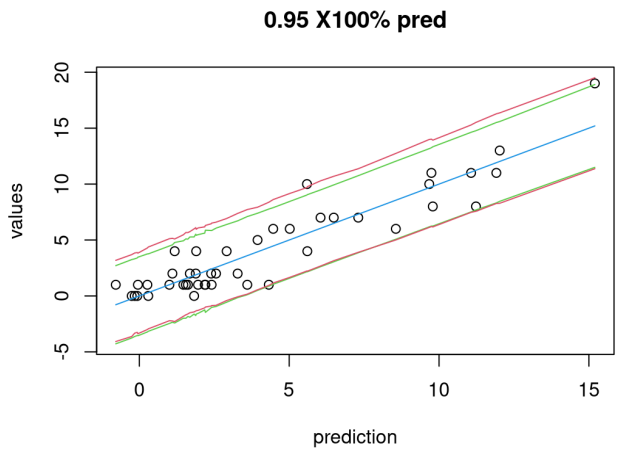
```
# fitting logistic regression models for drought
model_drought1 <- glm(Drought.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2), data =
drought, family = binomial)
model_drought2 <- glm(Drought.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2), data =
drought, family = binomial)

# fitting logistic regression models for Wildfire
model_wildfire1 <- glm(Wildfire.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2), data =
wildfire, family = binomial)
model_wildfire2 <- glm(Wildfire.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2), data =
wildfire, family = binomial)

# fitting linear regression models for Severe Storm
model_storm1 <- lm(Severe.Storm.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2),
data = storm)
model_storm2 <- lm(Severe.Storm.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2), data
= storm)

# fitting linear regression models for All Disasters
model_disaster1 <- lm(All.Disasters.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2),
data = alldisaster)
model_disaster2 <- lm(All.Disasters.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2),
data = alldisaster)

# fitting models using logitboot and lmboot for bootstrapping

# drought
boot_drought1 <- logitboot(Drought.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2),
drought, nboot = 1000)
boot_drought2 <- logitboot(Drought.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2),
drought, nboot = 1000)

# wildfire
boot_wildfire1 <- logitboot(Wildfire.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2),
wildfire, nboot = 1000)
boot_wildfire2 <- logitboot(Wildfire.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2),
wildfire, nboot = 1000)

# severe storm
boot_storm1 <- lmboot(Severe.Storm.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2),
storm, nboot = 1000)
boot_storm2 <- lmboot(Severe.Storm.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2),
storm, nboot = 1000)
```

# all disasters
boot_disaster1 <- lmboot(All.Disasters.Count ~ Year + I(Year^2) + delta.temp + I(delta.temp^2), alldisaster, nboot = 1000)
boot_disaster2 <- lmboot(All.Disasters.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2), alldisaster, nboot = 1000)

lmboot(All.Disasters.Count ~ delta.temp * Year - Year, NOAAGISSWD)
lmboot(All.Disasters.Count ~ I(delta.temp^2) + Year + delta.temp, NOAAGISSWD)

lmboot(Severe.Storm.Count ~ delta.temp * Year - Year, NOAAGISSWD)

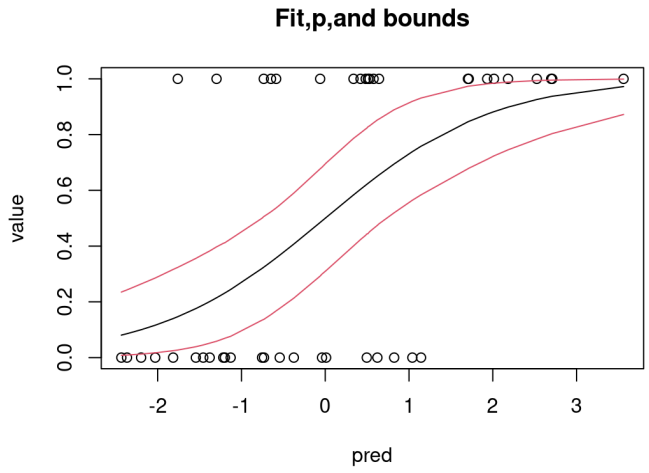
```
$coef
    (Intercept)      delta.temp delta.temp:Year
      3.5001463   -1097.0929693       0.5472525

$coef.point
      (Intercept) delta.temp delta.temp:Year
2.5%     1.869483 -1427.4028       0.4088354
97.5%    5.609036  -817.5857       0.7098669

$simultaneous
     (Intercept) delta.temp delta.temp:Year
[1,]  -0.1556483 -1691.5743       0.3483473
[2,]   8.5842280  -694.2356       0.8395200

$conf
[1] 0.95

$PRESS
[1] 137.1605
```



logitboot(Drought.Count ~ Year * delta.temp + I(Year^2) + I(delta.temp^2), drought)

logitboot(Wildfire.Count~delta.temp+I(Year^2)-1, NOAAGISSWD)

```
$alpha
[1] 0.05

$aic
[1] 49.50986

$coef
   delta.temp     I(Year^2)
 5.824457e+00 -7.950709e-07

$pointwiseCI
      delta.temp     I(Year^2)
2.5%    3.290233 -1.540879e-06
97.5%  11.063659 -4.098987e-07

$simultaneousCI
     delta.temp     I(Year^2)
[1,]   2.436985 -3.905683e-06
[2,]  25.229098 -2.410760e-07

Plausible!
```



logitboot(Wildfire.Count~Year*delta.temp+I(Year^2)-1+I(delta.temp^2) , NOAAGISSWD)

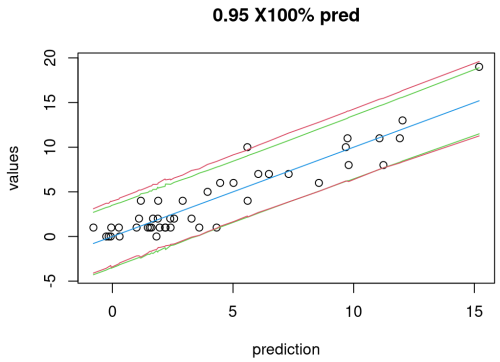
[not plausible] zeros in intervals

logitboot(Drought.Count~delta.temp, NOAAGISSWD)
[Not plausible] zeros in intervals

logitboot(Drought.Count~delta.temp*Year, NOAAGISSWD)
[Not plausible] zeros in intervals

lmboot(Severe.Storm.Count ~ delta.temp*Year - Year,NOAAGISSWD) [PLAUSIBLE]

```
$coef
    (Intercept)      delta.temp delta.temp:Year
      3.5001463   -1097.0929693       0.5472525

$coef.point
      (Intercept) delta.temp delta.temp:Year
2.5%     1.809389 -1425.7908       0.4075687
97.5%    5.544866  -814.4526       0.7098020

$simultaneous
     (Intercept) delta.temp delta.temp:Year
[1,]    0.297717 -1663.0190       0.3277611
[2,]    8.473719  -651.6685       0.8266144

$conf
[1] 0.95

$PRESS
[1] 137.1605
```

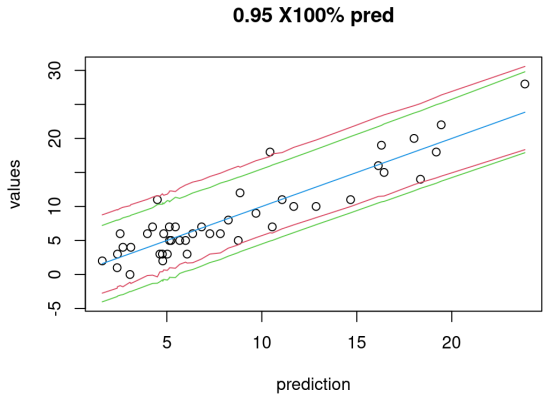


lmboot(Severe.Storm.Count ~ delta.temp + Year, NOAAGISSWD)
[Not plausible] zeros in intervals

lmboot(All.Disasters.Count ~ delta.temp*Year - Year,NOAAGISSWD) [PLAUSIBLE]

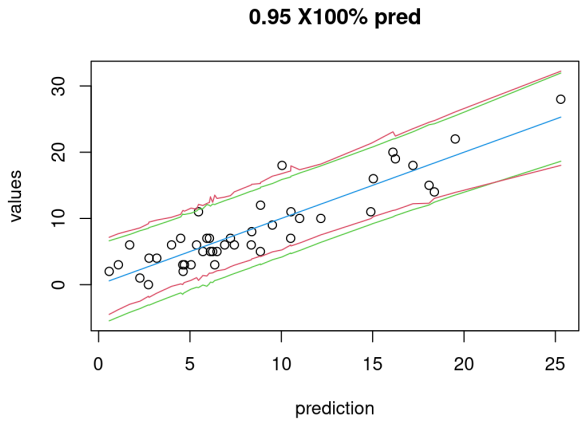
```
$coef
    (Intercept)      delta.temp delta.temp:Year
      7.0945835   -1477.3653920       0.7373628

$coef.point
      (Intercept) delta.temp delta.temp:Year
2.5%     4.022585 -2009.6656       0.4842644
97.5%   10.854360  -965.3773       0.9994218

$simultaneous
     (Intercept) delta.temp delta.temp:Year
[1,]    1.818941 -2408.2693       0.3487642
```

```
[2,]   15.147936  -691.1777       1.1954488

$conf
[1] 0.95

$PRESS
[1] 349.8295
```

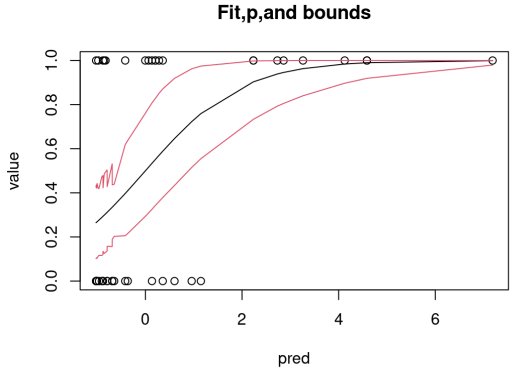


lmboot(All.Disasters.Count ~ I(delta.temp^2) + Year + delta.temp,NOAAGISSWD) [PLAUSIBLE]

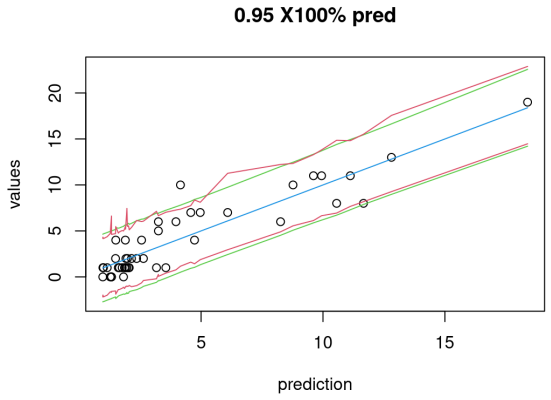
```
$coef
    (Intercept) I(delta.temp^2)            Year      delta.temp
   -701.1246857      28.7285652       0.3578963     -31.5661007

$coef.point
      (Intercept) I(delta.temp^2)      Year delta.temp
2.5%   -1137.1914        15.24162 0.1711554  -48.05608
97.5%   -333.4787        38.90234 0.5780951  -15.64465

$simultaneous
     (Intercept) I(delta.temp^2)       Year delta.temp
[1,] -1467.09027        1.596802 0.04848457 -75.597701
[2,]   -88.15436       52.213691 0.74595039  -3.641618

$conf
[1] 0.95

$PRESS
[1] 383.4326
```



```
logitboot(Wildfire.Count ~ delta.temp + I(delta.temp^2) - 1, NOAAGISSWD)


$alpha
[1] 0.05

$aic
[1] 50.92199

$coef
     delta.temp I(delta.temp^2)
      -6.701762       10.978013

$pointwiseCI
      delta.temp I(delta.temp^2)
2.5%  -14.225147        5.525354
97.5%  -2.729194       24.454052

$simultaneousCI
     delta.temp I(delta.temp^2)
[1,] -24.870535        3.687148
[2,]  -1.335035       43.611328
```

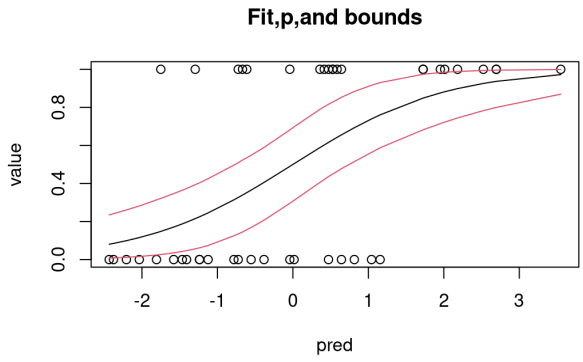


```
lmboot(Severe.Storm.Count ~ Year * I(delta.temp^2) - Year, NOAAGISS)
$coef
         (Intercept)      I(delta.temp^2) Year:I(delta.temp^2)
           2.1536882        -1080.9807546            0.5402085

$coef.point
      (Intercept) I(delta.temp^2) Year:I(delta.temp^2)
2.5%     1.170907      -1472.1001            0.3451501
97.5%    3.215336       -686.1084            0.7336645

$simultaneous
     (Intercept) I(delta.temp^2) Year:I(delta.temp^2)
[1,]   0.6898658      -1807.8023            0.1965312
[2,]   4.3727934       -388.1616            0.8996514

$conf
[1] 0.95

$PRESS
[1] 148.1495
```

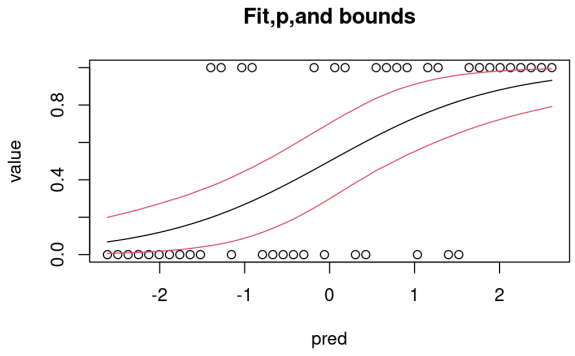



```
logitboot(Wildfire.Count~delta.temp,NOAAGISS)
$alpha
[1] 0.05

$aic
[1] 49.40551

$coef
(Intercept)  delta.temp
  -3.117966    5.698753

$pointwiseCI
      (Intercept) delta.temp
```

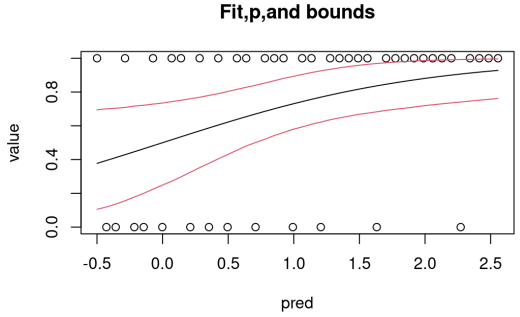
```
2.5%    -6.088326    3.15400
97.5%   -1.599687   10.88487

$simultaneousCI
     (Intercept) delta.temp
[1,]  -16.558125   2.335633
[2,]   -1.193882  30.365885
```




```
logitboot(Wildfire.Count~Year,NOAAGISS)
$alpha
[1] 0.05

$aic
[1] 47.78727

$coef
 (Intercept)          Year
-243.4478775    0.1216327

$pointwiseCI
      (Intercept)       Year
2.5%    -449.7443 0.07024042
97.5%   -140.5188 0.22452427

$simultaneousCI
     (Intercept)       Year
[1,]  -1081.0364 0.05942513
[2,]   -119.1621 0.54015260
```




```
logitboot(Drought.Count ~ Year, NOAAGISS, 500)
$alpha
[1] 0.05

$aic
[1] 51.15299

$coef
  (Intercept)          Year
-141.19883593    0.07106025

$pointwiseCI
      (Intercept)       Year
2.5%   -323.88167 0.01565903
97.5%   -30.66282 0.16266751

$simultaneousCI
     (Intercept)       Year
[1,]  -694.40352 0.00776318
[2,]   -14.33518 0.34983868
```




```
logitboot(Drought.Count ~ Year, NOAAGISS)
$alpha
```

```
[1] 0.05

$aic
[1] 51.15299

$coef
  (Intercept)          Year
-141.19883593    0.07106025

$pointwiseCI
      (Intercept)       Year
2.5%   -336.95313 0.01483237
97.5%   -28.79483 0.16915918

$simultaneousCI
       (Intercept)        Year
[1,] -1108.8423712 0.001020183
[2,]    -0.8200136 0.556546019
```