

Detecting density dependence

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Introduction

From the terns data you've already worked with, we see that population size at the islands typically reaches a carrying capacity, but summed over all islands, the population appears to exhibit unbounded growth. Why is this? This exercise uses R to analyze these data. Specifically, we seek to test for density dependence. We expect it to be present in the local (single-island) population and absent in the overall (total) population.

First, read in the data on Buzzard Bay tern populations.

```
bird.data<-read.csv("buzzard_bay2.csv",header=TRUE)
```

Now, plot both the total population size in the region and the local population size on Bird Island.

```
plot(bird.data$year,bird.data$total_size,type="b",col="black",lty=1,xlab="Year",ylab="Population size")  
lines(bird.data$year,bird.data$local_size,type="b",col="gray",lty=2)
```



Here we calculate change in population size between successive years for the 2 populations.

```
l_total<-NULL  
l_local<-NULL# create empty lists to store information  
  
for (i in 1:(length(bird.data$year)-1)){  
  l_total<-rbind(l_total,bird.data$total_size[i+1]/bird.data$total_size[i])  
  l_local<-rbind(l_local,bird.data$local_size[i+1]/bird.data$local_size[i])  
}
```

Next, plot change in population size as function of population size, calculate the best straight lines to fit the data sets, and plot.

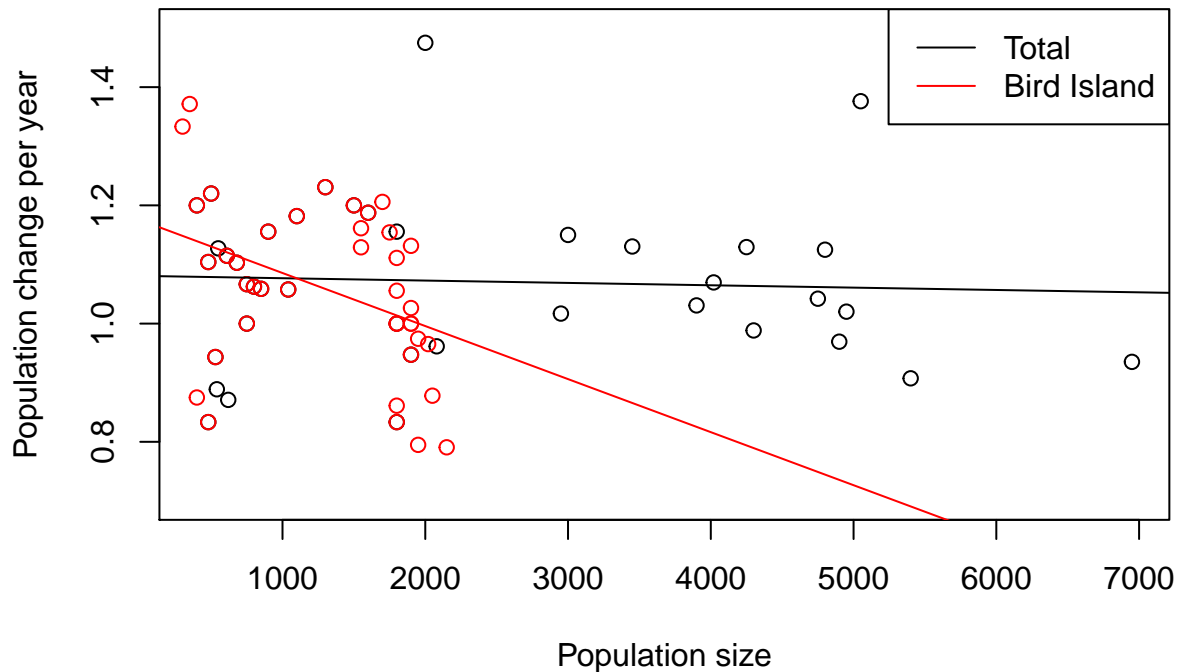
```

plot(bird.data$total_size[1:(length(bird.data$year)-1)],l_total,type="p",lty=1,col="black",xlab="Popula
lines(bird.data$local_size[1:(length(bird.data$year)-1)],l_local,type="p",lty=1,col="red")
legend("topright",c("Total","Bird Island"),lty=c(1,1),col=c("black","red"))

model.t<-lm(l_total~bird.data$total_size[1:(length(bird.data$year)-1)])
model.l<-lm(l_local~bird.data$local_size[1:(length(bird.data$year)-1)])

abline(model.t,col="black")
abline(model.l,col="red")

```



```

#obtain info on straight line fit (statistical significane, % variation explained by population size)
summary(model.t)

```

```

##
## Call:
## lm(formula = l_total ~ bird.data$total_size[1:(length(bird.data$year) -
## 1)])
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.24549 -0.08127 -0.01306  0.07911  0.40223
##
## Coefficients:
##              Estimate Std. Error
## (Intercept)      1.081e+00  3.466e-02
## bird.data$total_size[1:(length(bird.data$year) - 1)] -3.978e-06  1.204e-05
##
##              t value Pr(>|t|)
## (Intercept)      31.18  <2e-16 ***
## bird.data$total_size[1:(length(bird.data$year) - 1)]  -0.33   0.743
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##

```

```
## Residual standard error: 0.1366 on 38 degrees of freedom
## Multiple R-squared: 0.002863, Adjusted R-squared: -0.02338
## F-statistic: 0.1091 on 1 and 38 DF, p-value: 0.743
```

```
summary(model.1)
```

```
##
## Call:
## lm(formula = l_local ~ bird.data$local_size[1:(length(bird.data$year) -
##      1)])
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.298903 -0.045363 -0.008581  0.099307  0.227525
##
## Coefficients:
##                                     Estimate Std. Error
## (Intercept)                       1.175e+00  4.933e-02
## bird.data$local_size[1:(length(bird.data$year) - 1)] -8.974e-05  3.420e-05
##                                     t value Pr(>|t|)
## (Intercept)                        23.826   <2e-16 ***
## bird.data$local_size[1:(length(bird.data$year) - 1)] -2.624   0.0124 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1318 on 38 degrees of freedom
## Multiple R-squared: 0.1534, Adjusted R-squared: 0.1311
## F-statistic: 6.885 on 1 and 38 DF, p-value: 0.01245
```