

Example

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R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>. A concise R markdown cheatsheet can be found at <https://github.com/rstudio/cheatsheets/raw/main/rmarkdown-2.0.pdf>.

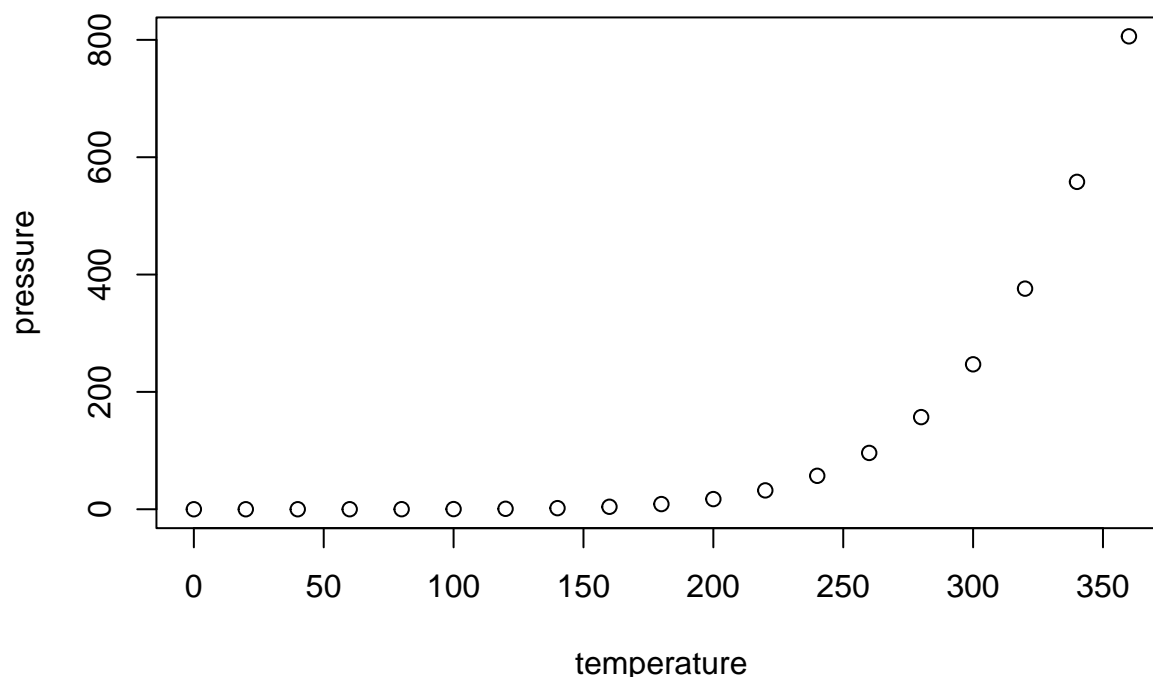
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed      dist
##  Min.   : 4.0    Min.   :  2.00
##  1st Qu.:12.0    1st Qu.: 26.00
##  Median :15.0    Median : 36.00
##  Mean   :15.4    Mean   : 42.98
##  3rd Qu.:19.0    3rd Qu.: 56.00
##  Max.   :25.0    Max.   :120.00
```

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

For this course

For this course, I want to see the code you use, so make sure NOT to set `echo=FALSE`. By using an `.Rmd` file, I can see exactly what you did and what it produced.

Documenting object structure

```
avonet <- read.csv("https://github.com/bmaitner/Statistical_ecology_course/raw/refs/heads/main/data/Avon")
str(avonet)
```

```
## 'data.frame':    11009 obs. of  37 variables:
## $ Sequence      : int  3103 3090 3125 3116 3092 3091 3089 3115 3130 3123 ...
## $ Species1      : chr   "Accipiter albogularis" "Accipiter badius" "Accipiter bicolor" "Accipiter ..."
## $ Family1       : chr   "Accipitridae" "Accipitridae" "Accipitridae" "Accipitridae" ...
## $ Order1        : chr   "Accipitriformes" "Accipitriformes" "Accipitriformes" "Accipitriformes" ...
## $ Avibase.ID1    : chr   "AVIBASE-BBB59880" "AVIBASE-1A0ECB6E" "AVIBASE-ADBE44E1" "AVIBASE-68BF92 ..."
## $ Total.individuals : int   5 10 11 4 8 1 6 5 7 5 ...
## $ Female        : int   2 4 4 4 4 0 2 2 1 2 ...
## $ Male          : int   0 6 5 0 4 1 2 3 5 3 ...
```

```
## $ Unknown      : int  3 0 2 0 0 0 2 0 1 0 ...
## $ Complete.measures : int  4 8 8 3 4 1 4 4 6 4 ...
## $ Beak.Length_Culmen: num 27.7 20.6 25 22.5 21.1 20 20.5 19.2 20 25.4 ...
## $ Beak.Length_Nares : num 17.8 12.1 13.7 14 12.1 11.9 11.5 10.6 11.2 13.9 ...
## $ Beak.Width      : num 10.6 8.8 8.6 8.9 8.7 6.6 8.3 7.7 8.6 8.6 ...
## $ Beak.Depth      : num 14.7 11.6 12.7 11.9 11.1 12 10.9 9.6 11 13.2 ...
## $ Tarsus.Length   : num 62 43 58.1 61.2 46.4 48.7 52.6 60.3 43.6 62 ...
## $ Wing.Length     : num 235 187 230 202 218 ...
## $ Kipps.Distance  : num 81.8 62.5 56.6 64.1 87.8 42.9 38.9 81.3 49.5 77.8 ...
## $ Secondary1      : num 160 127 175 138 130 ...
## $ Hand.Wing.Index  : num 33.9 32.9 24.6 31.7 40.2 25.8 24 37.8 30 32.3 ...
## $ Tail.Length     : num 169 141 186 141 154 ...
## $ Mass            : num 249 131 288 142 186 ...
## $ Mass.Source      : chr "Dunning" "Dunning" "Dunning" "Dunning" ...
## $ Mass.Refs.Other  : chr NA NA NA NA ...
## $ Inference        : chr "NO" "NO" "NO" "NO" ...
## $ Traits.inferred  : chr NA NA NA NA ...
## $ Reference.species : chr NA NA NA NA ...
## $ Habitat          : chr "Forest" "Shrubland" "Woodland" "Forest" ...
## $ Habitat.Density  : int 1 2 2 1 1 1 1 1 1 2 ...
## $ Migration        : int 2 3 2 2 3 1 2 2 2 3 ...
## $ Trophic.Level    : chr "Carnivore" "Carnivore" "Carnivore" "Carnivore" ...
## $ Trophic.Niche    : chr "Vertivore" "Vertivore" "Vertivore" "Vertivore" ...
## $ Primary.Lifestyle : chr "Insessorial" "Insessorial" "Generalist" "Insessorial" ...
## $ Min.Latitude     : num -11.73 -29.47 -55.72 -6.31 31.19 ...
## $ Max.Latitude     : num -4.02 46.39 23.73 -4.08 55.86 ...
## $ Centroid.Latitude : num -8.15 8.23 -10.1 -5.45 45.24 ...
## $ Centroid.Longitude : num 158.5 45 -60 150.7 45.3 ...
## $ Range.Size       : num 37461 22374973 14309701 35581 2936752 ...
```

Example Figure 1

```
plot(x = avonet$Centroid.Latitude,
     y = log10(avonet$Range.Size),
     xlab = "Centroid Latitude",
     ylab = "Range Size")
trend_line <- lm(log10(avonet$Range.Size)~avonet$Centroid.Latitude)
abline(trend_line,col="blue",lwd=3)
```

Example Figure 2: The importance of proper scale

In biology, some patterns are often more easily seen when transformed in some way. The log transformation is a common transformation that has strong biological justifications. We'll see why this is so later, but for now just take my word for it.

```
plot(x = avonet$Mass,
     y = avonet$Wing.Length,
     xlab = "Mass",
     ylab = "Wing Length")
```

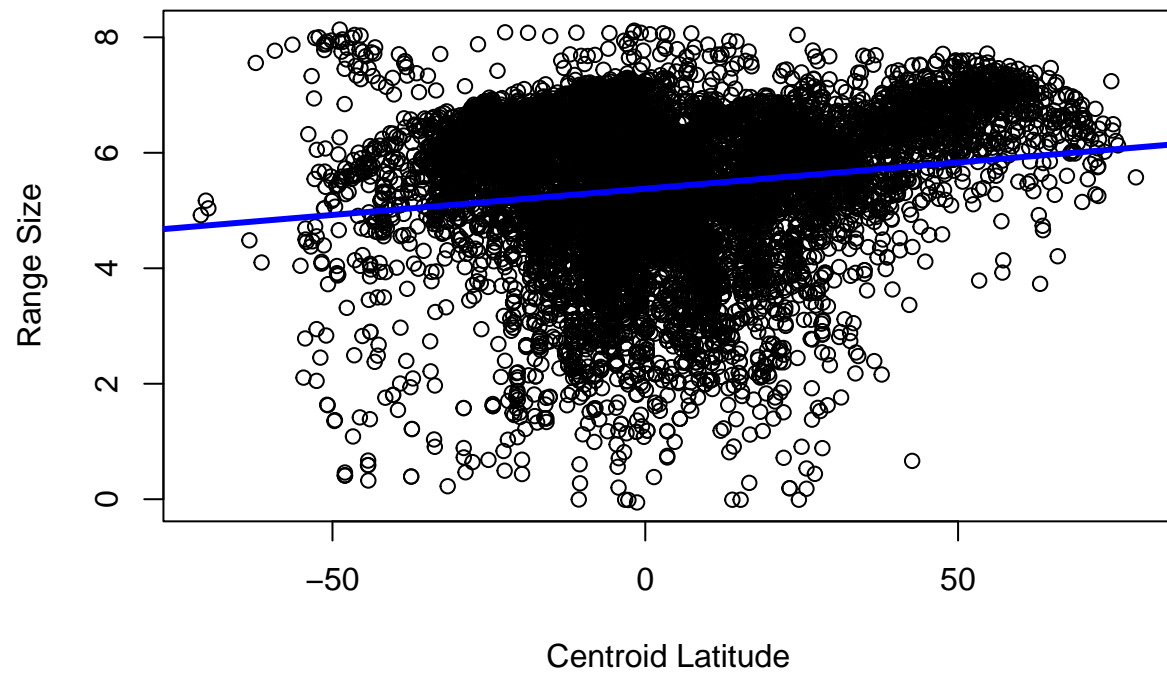
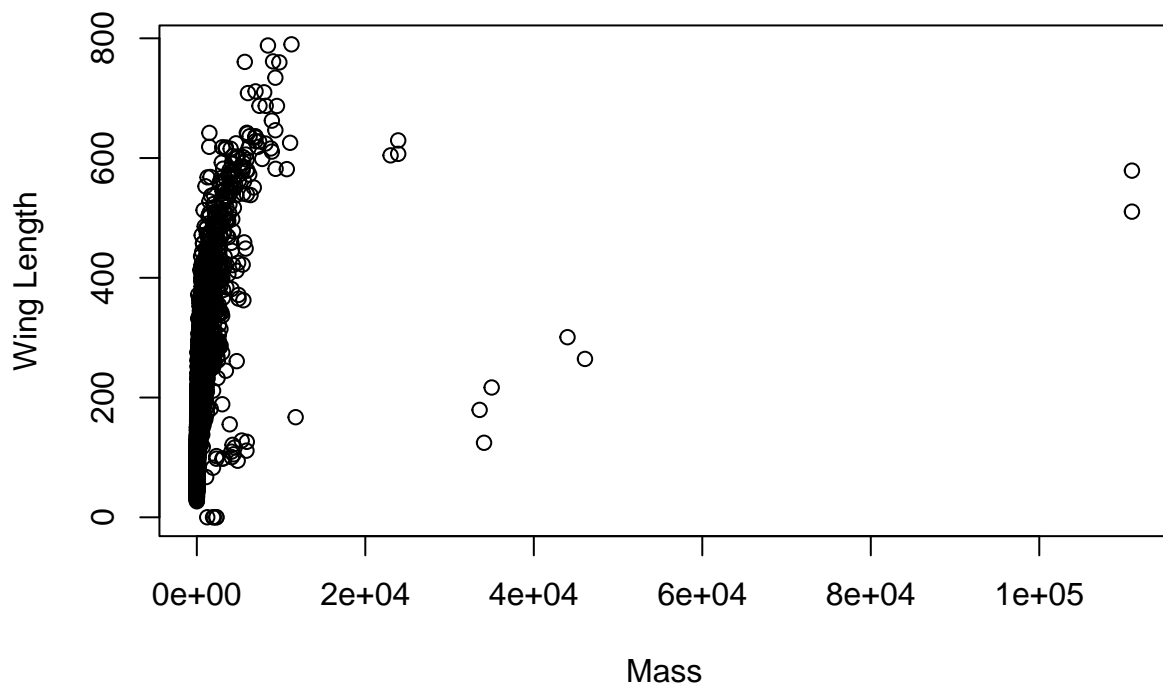
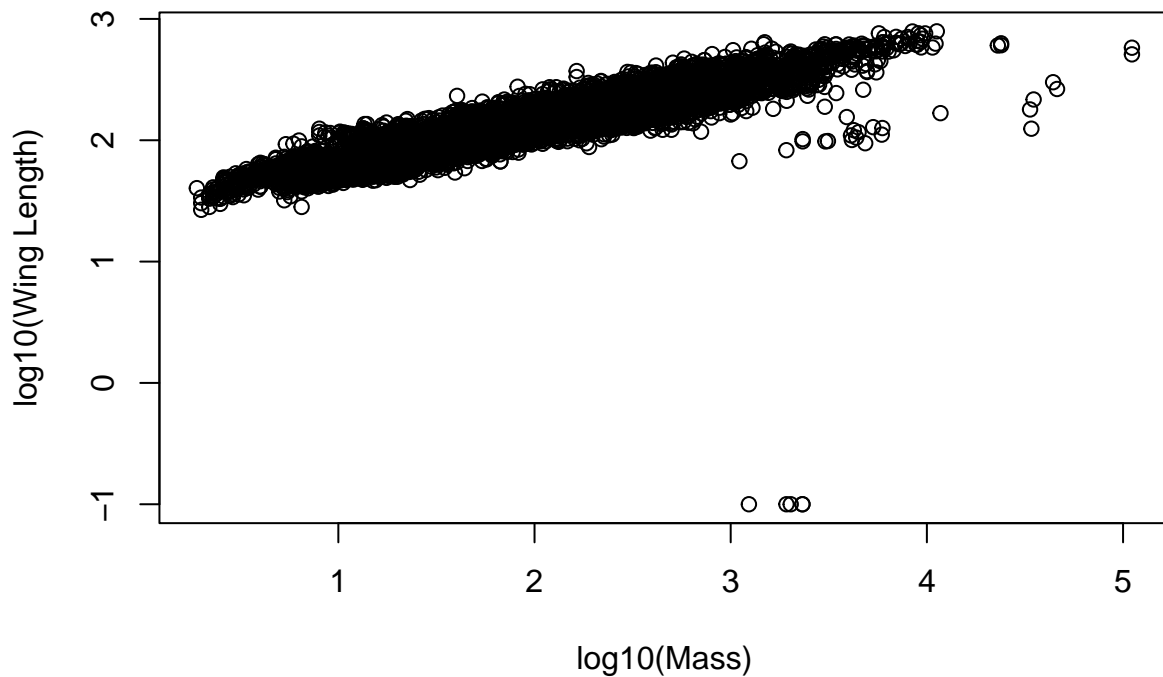


Figure 1: Figure 1. Range size increases with latitude



The pattern doesn't appear very obvious here. There might be a relationship, but it's a bit hard to tell. Let's do a \log_{10} transformation instead.

```
plot(x = log10(avonet$Mass),  
     y = log10(avonet$Wing.Length),  
     xlab = "log10(Mass)",  
     ylab = "log10(Wing Length)")
```



Much more clear now!

Example Figure 3

```
Pelecaniformes <- subset(x = avonet,
  subset = Order1 == "Pelecaniformes")

names(Pelecaniformes)[4] <- "Order" #Rename Order1 to Order
names(Pelecaniformes)[3] <- "Family" #Rename Order1 to Order

boxplot(data=Pelecaniformes, log10(Mass) ~ Family)
```

Example table

```
avonet_continuous_traits <-
avonet[c("Beak.Length_Culmen",
  "Beak.Length_Nares",
  "Beak.Width",
  "Beak.Depth",
  "Tarsus.Length",
  "Wing.Length",
  "Kipps.Distance",
```

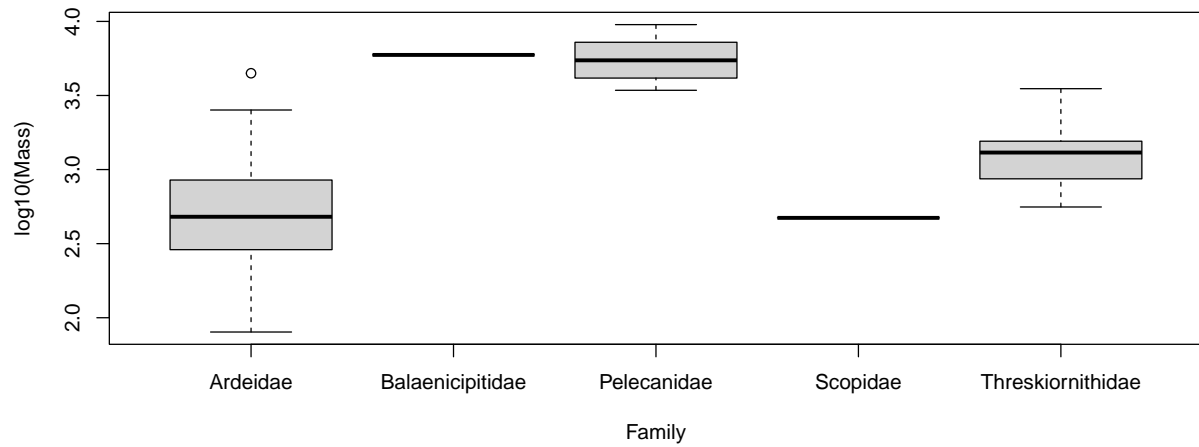


Figure 2: Figure 3. Body size varies across families in the Pelecaniformes

```

"Secondary1",
"Hand.Wing.Index",
"Tail.Length",
"Mass")]]

avonet_beak <- avonet[c("Beak.Length_Culmen",
                        "Beak.Length_Nares",
                        "Beak.Width",
                        "Beak.Depth")]

round(cor(avonet_beak),2)

##           Beak.Length_Culmen Beak.Length_Nares Beak.Width Beak.Depth
## Beak.Length_Culmen           1.00           0.97      0.74      0.71
## Beak.Length_Nares           0.97           1.00      0.73      0.70
## Beak.Width                 0.74           0.73      1.00      0.91
## Beak.Depth                 0.71           0.70      0.91      1.00

```