hawks

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hawks

references:
- Cannon, et al., Stat2, chapter 05, example 5.9

Import the data.

```
data <- read.csv("Hawks.csv", header=TRUE)
head(data, 3)
```

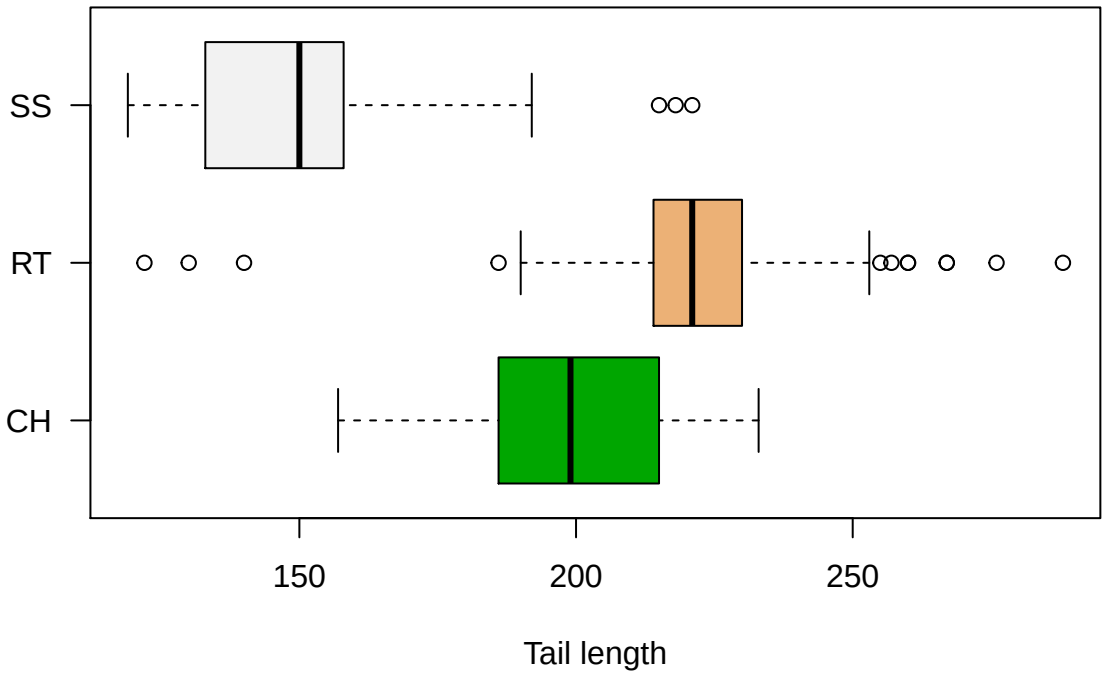
```
##   Month Day Year CaptureTime ReleaseTime BandNumber Species Age Sex Wing
## 1     9  19 1992       13:30              877-76317      RT   I      385
## 2     9  22 1992       10:30              877-76318      RT   I      376
## 3     9  23 1992       12:45              877-76319      RT   I      381
##   Weight Culmen Hallux Tail StandardTail Tarsus WingPitFat KeelFat Crop
## 1    920   25.7   30.1  219           NA     NA         NA      NA   NA
## 2    930     NA     NA  221           NA     NA         NA      NA   NA
## 3    990   26.7   31.3  235           NA     NA         NA      NA   NA
```

```
dim(data)
```

```
## [1] 908  19
```

View the data.

```
plot(Tail ~ Species, data=data, horizontal=TRUE,
     col=terrain.colors(3), las=1, xlab="", ylab="Tail length")
```



Group statistics.

```
n <- with(data, tapply(Tail, Species, length))
mean <- with(data, round(tapply(Tail, Species, mean), 3))
sd <- with(data, round(tapply(Tail, Species, sd), 3))
hawks.statistics <- cbind(n, mean, sd)
hawks.statistics
```

```
##      n    mean     sd
## CH  70 200.914 17.880
## RT 577 222.149 14.511
## SS 261 146.724 15.676
```

```
grand.mean <- cbind(n = length(data$Tail),
                    mean = mean(data$Tail),
                    sd = sd(data$Tail))
rownames(grand.mean) <- c("Total")
grand.mean <- round(grand.mean, 3)
grand.mean
```

```
##         n    mean     sd
## Total 908 198.831 36.824
```

Model: ANOVA with `aov`

```
hawks.aov <- aov(Tail ~ Species, data=data)
hawks.aov
```

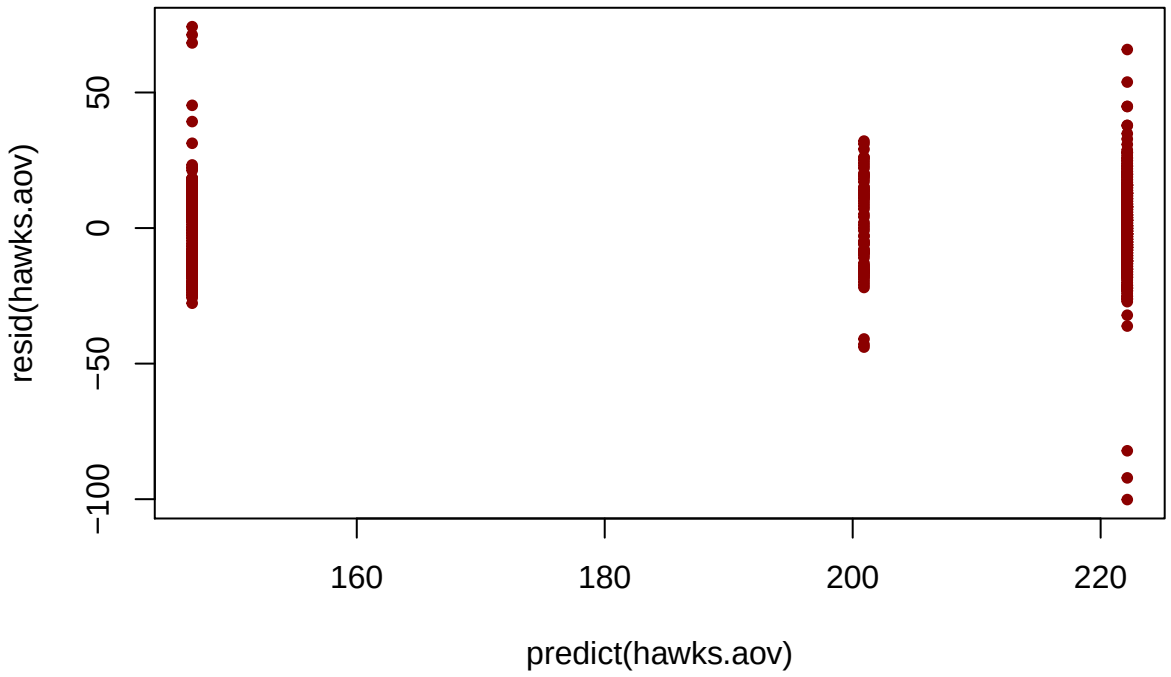
```
## Call:
##    aov(formula = Tail ~ Species, data = data)
##
## Terms:
##                   Species Residuals
## Sum of Squares  1022684.4  207240.8
## Deg. of Freedom         2       905
##
## Residual standard error: 15.13259
## Estimated effects may be unbalanced
```

```
options(show.signif.stars=FALSE)
summary(hawks.aov)
```

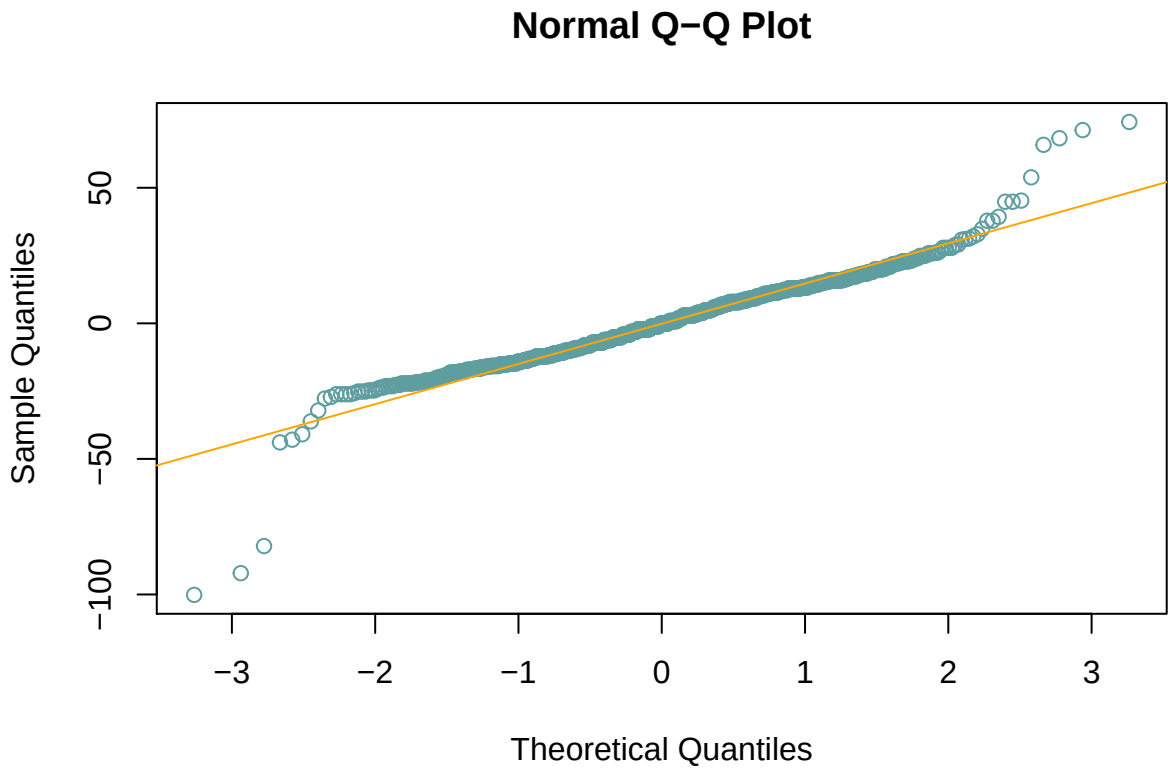
```
##              Df  Sum Sq Mean Sq F value Pr(>F)
## Species       2 1022684  511342    2233 <2e-16
## Residuals   905  207241     229
```

Residuals.

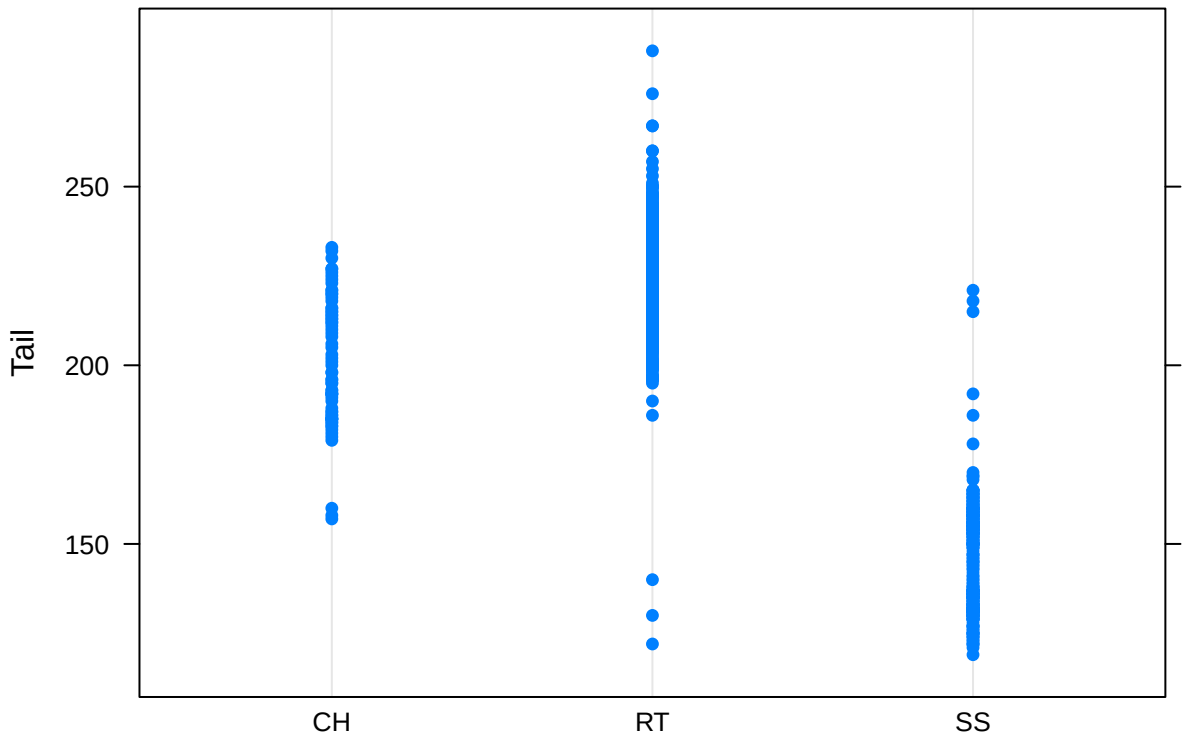
```
plot(predict(hawks.aov), resid(hawks.aov),
     pch=20, col="darkred")
```



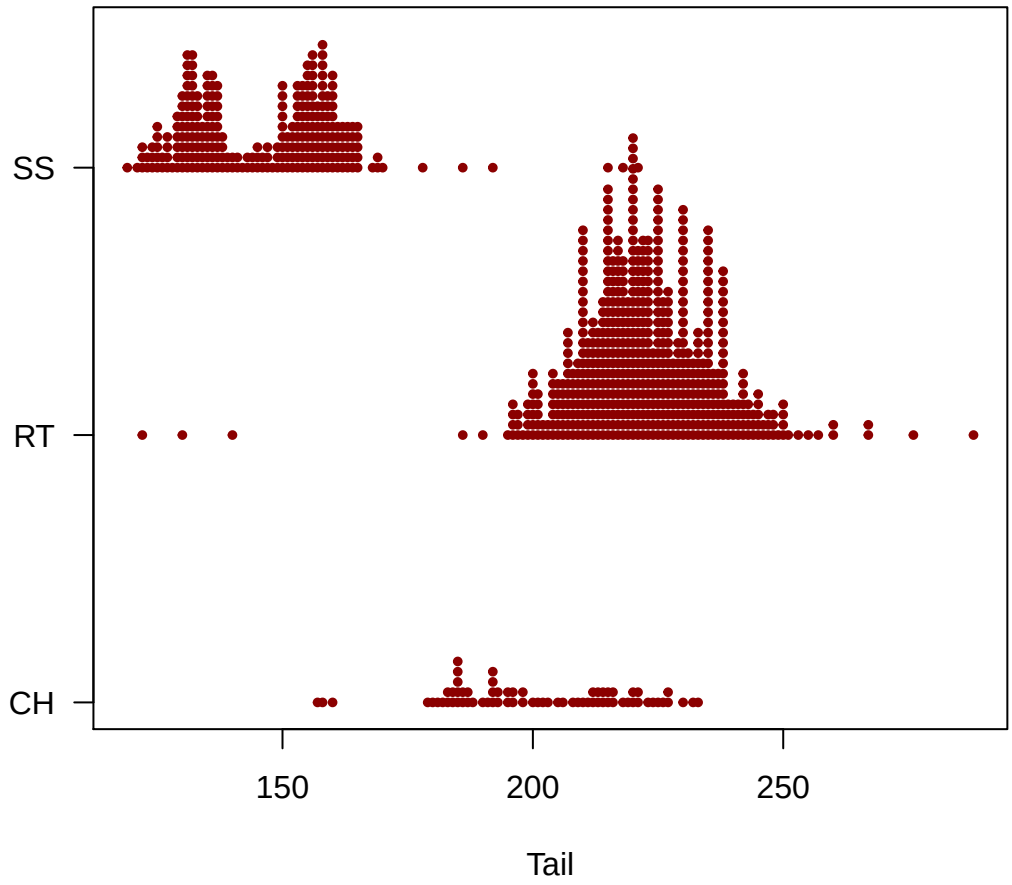

```
qqnorm(resid(hawks.aov), col="cadetblue")
qqline(resid(hawks.aov), col="orange")
library(lattice)
```




```
dotplot(Tail ~ Species, data=data, jitter=TRUE)
```




```
stripchart(Tail ~ Species, data=data,
           pch=20, cex=0.8, las=1, col="darkred", method="stack")
```



```
std.dev <- hawks.statistics[ , 3]
std.dev
```

```
##     CH     RT     SS
## 17.880 14.511 15.676
```

```
ratio <- max(std.dev) / min(std.dev)
ratio
```

```
## [1] 1.232169
```

Note the bimodal tail length distributions for the two *Accipiters*.
Female Sharp-shinned Hawks and Cooper's Hawks have longer tails.