STAT 217: Handout 11-19

To orient themselves with respect to their surroundings, some bats use echolocation. Such a trait has evolved in very few animal species, perhaps because of the high energy costs involved in producing pulses. Zoologists collected data on in-flight energy expenditure (watts) and body mass (g) from 20 energy studies on three types of flying vertebrates: echolocating bats, non-echolocating bats, and non-echolocating birds.

```
lm.bats.1 <- lm(ENERGY~TYPE+MASS,data=bats)
summary(lm.bats.1)

##
## Call:
## lm(formula = ENERGY ~ TYPE + MASS, data = bats)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -5.820 -3.671 -0.951  1.150 13.990
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 1.42126    2.66068    0.53     0.60
## TYPEnon-echolocating bats   1.16851    5.14511    0.23     0.82
## TYPEnon-echolocating birds  4.60072    3.53711    1.30     0.21
## MASS                        0.05750    0.00756    7.61  1.1e-06
##
## Residual standard error: 5.3 on 16 degrees of freedom
## Multiple R-squared:  0.879,Adjusted R-squared:  0.856
## F-statistic: 38.8 on 3 and 16 DF,  p-value: 1.44e-07
```

```r
lm.bats.2 <- lm(ENERGY~TYPE+MASS+MASS*TYPE,data=bats)
summary(lm.bats.2)
```

```
##
## Call:
## lm(formula = ENERGY ~ TYPE + MASS + MASS * TYPE, data = bats)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -8.049 -2.271 -0.082  0.994 12.460
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                      0.4940     3.1947    0.15     0.88
## TYPEnon-echolocating bats       10.7334     7.0617    1.52     0.15
## TYPEnon-echolocating birds       2.8228     4.2646    0.66     0.52
## MASS                             0.0896     0.0680    1.32     0.21
## TYPEnon-echolocating bats:MASS  -0.0496     0.0690   -0.72     0.48
## TYPEnon-echolocating birds:MASS -0.0219     0.0687   -0.32     0.75
##
## Residual standard error: 5.04 on 14 degrees of freedom
## Multiple R-squared:  0.904,Adjusted R-squared:  0.87
## F-statistic: 26.5 on 5 and 14 DF,  p-value: 1.14e-06
```

```r
anova(lm.bats.2)
```

```
## Analysis of Variance Table
##
## Response: ENERGY
##           Df Sum Sq Mean Sq F value  Pr(>F)
## TYPE       2   1645     822   32.37 5.6e-06
## MASS       1   1628    1628   64.08 1.4e-06
## TYPE:MASS  2     94      47    1.86    0.19
## Residuals 14    356      25
```