R Handout - Simple Linear Regression

Dr. Derek Ogle
Northland College

Winter 2015, MTH207 Biometry

1 Initialization

```
> library(NCStats)
```

2 Salmon Sperm Example

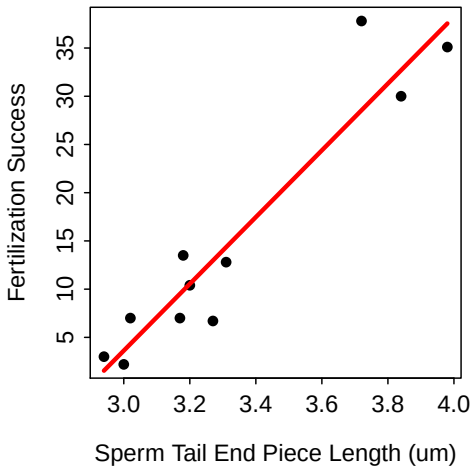
2.1 Data Preparation

```
> ss <- read.csv("https://raw.githubusercontent.com/droglenc/NCData/master/SalmonSperm.csv")
```

```
> str(ss)
'data.frame': 11 obs. of  3 variables:
 $ step.len : num  2.94 3 3.02 3.17 3.18 3.2 3.27 3.31 3.72 3.84 ...
 $ fert.succ: num  3 2.2 7 7 13.5 10.4 6.7 12.8 37.8 30 ...
 $ mat      : Factor w/ 2 levels "Adult","Parr": 2 2 1 2 1 1 1 1 2 2 ...
> xlbl <- "Sperm Tail End Piece Length (um)"
> ylbl <- "Fertilization Success"
```

2.2 Lecture Support I – Model Fitting and Simple Predictions

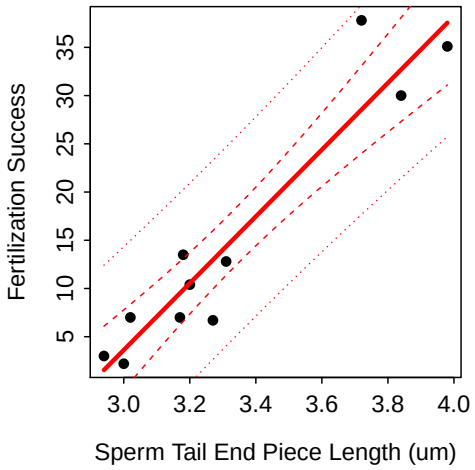
```
> ( lm1 <- lm(fert.succ~step.len,data=ss) )
Coefficients:
(Intercept)     step.len
    -100.21        34.61
> fitPlot(lm1,xlab=xlbl,ylab=ylbl,main="")
```



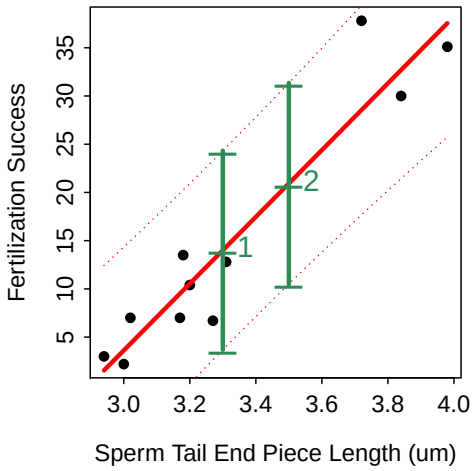

```
> predict(lm1,data.frame(step.len=3.5))
       1
20.92912
```

2.3 Lecture Support II – Sampling Variability

```
> summary(lm1)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -100.205     13.015  -7.699 3.00e-05
step.len      34.610      3.889   8.901 9.35e-06

Residual standard error: 4.366 on 9 degrees of freedom
Multiple R-squared: 0.898,Adjusted R-squared: 0.8866
F-statistic: 79.22 on 1 and 9 DF,  p-value: 9.35e-06

> confint(lm1)

                2.5 %    97.5 %
(Intercept) -129.64815 -70.76202
step.len      25.81336  43.40619

> fitPlot(lm1,interval="both",xlab=xlbl,ylab=ylbl,main="")
```




```
> predict(lm1,data.frame(step.len=3.5),interval="confidence")

       fit     lwr      upr
1 20.92912 17.5967 24.26153

> predict(lm1,data.frame(step.len=3.5),interval="prediction")

       fit      lwr      upr
1 20.92912 10.50502 31.35321

> predictionPlot(lm1,data.frame(step.len=c(3.3,3.5)),interval="prediction",
 xlab=xlbl,ylab=ylbl,main="")

  obs step.len      fit       lwr      upr
1   1      3.3 14.00716  3.687506 24.32682
2   2      3.5 20.92912 10.505016 31.35321
```

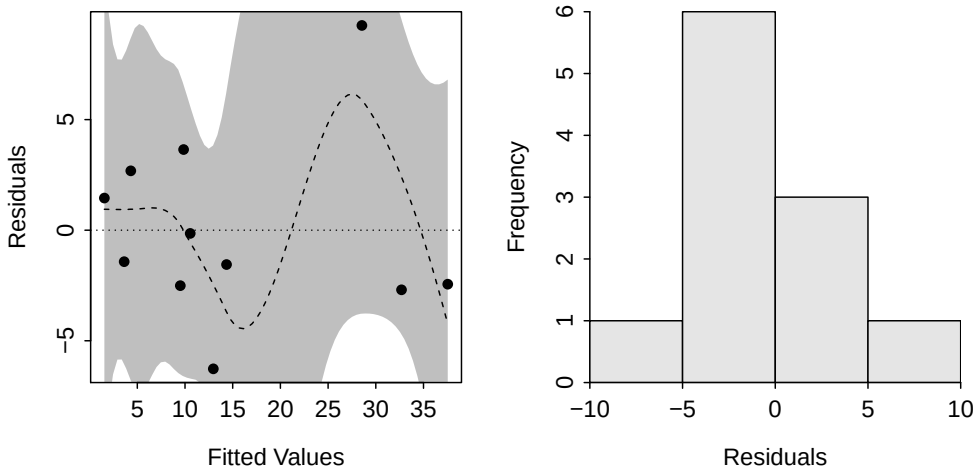


2.4 Lecture Support III – Model Comparisons

```
> anova(lm1)
          Df  Sum Sq Mean Sq F value   Pr(>F)
step.len   1 1510.23 1510.23  79.219 9.35e-06
Residuals  9  171.58   19.06
Total     10 1681.81
```

2.5 Lecture Support IV – Assumption Checking

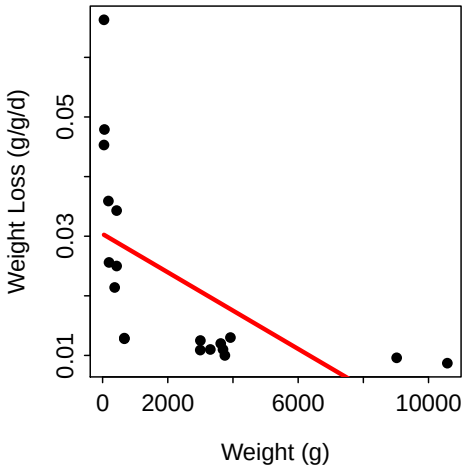
```
> residPlot(lm1,main="")
```



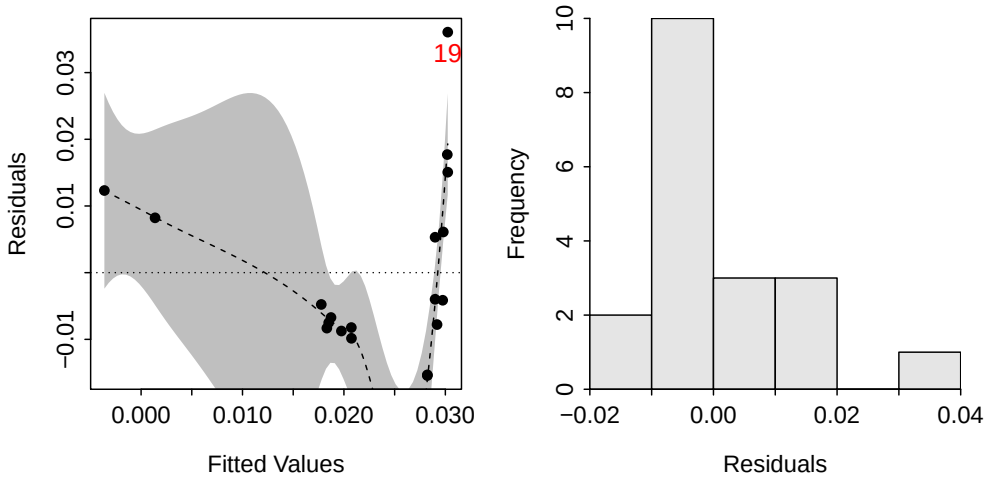

```
> adTest(lm1$residuals)
Anderson-Darling normality test with lm1$residuals
A = 0.4022, p-value = 0.2962
> outlierTest(lm1)

No Studentized residuals with Bonferonni p < 0.05
Largest |rstudent|:
   rstudent unadjusted p-value Bonferonni p
12 3.717896          0.0058892     0.064781
```

3 Petrels Example

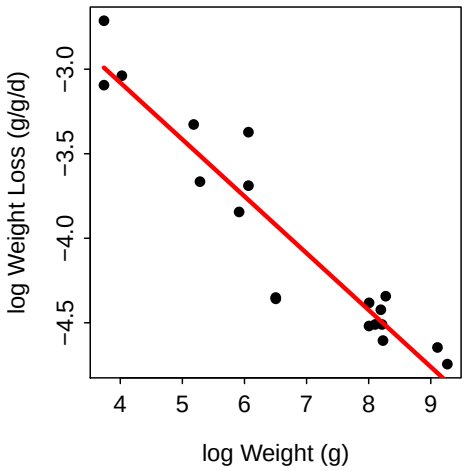
```
> petrels <- read.csv("https://raw.githubusercontent.com/droglenc/NCData/master/Petrels.csv")
> str(petrels)
'data.frame': 19 obs. of  4 variables:
 $ species    : Factor w/ 13 levels "Diomedea chrysostoma",..: 2 2 4 4 1 1 3 3 3 9 ...
 $ sex        : Factor w/ 4 levels "both","female",..: 3 2 3 2 3 2 3 2 1 3 ...
 $ weight     : int  10577 9022 3922 3694 3751 3624 3305 3000 2996 668 ...
 $ weight.loss: num  0.0087 0.0096 0.013 0.011 0.01 0.012 0.011 0.0125 0.0109 0.0128 ...
> lm1 <- lm(weight.loss~weight,data=petrels)
> fitPlot(lm1,xlab="Weight (g)",ylab="Weight Loss (g/g/d)",main="")
```



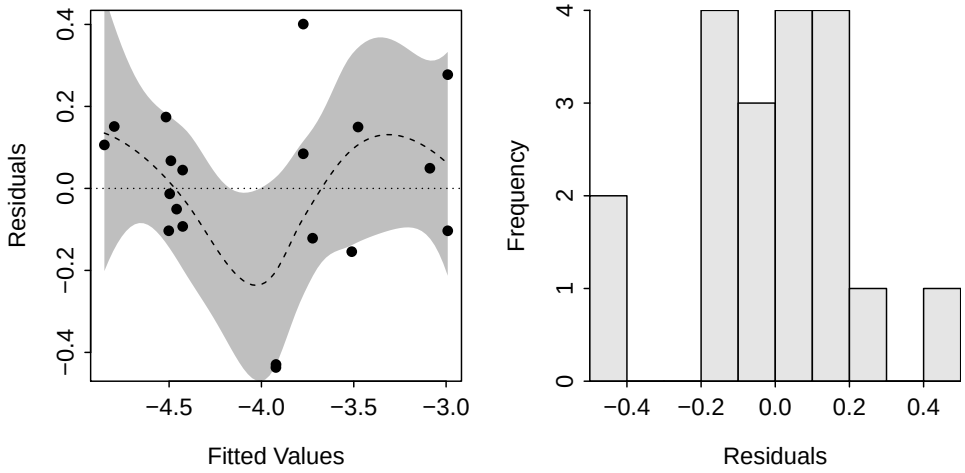

```
> residPlot(lm1,main="")
```




```
> with(petrels,max(weight)/min(weight))
[1] 251.8333
> ## transChooser(lm1) # interactive, results not shown
> petrels$log.wt <- log(petrels$weight)
> petrels$log.wtloss <- log(petrels$weight.loss)
> lm2 <- lm(log.wtloss~log.wt,data=petrels)
> fitPlot(lm2,xlab="log Weight (g)",ylab="log Weight Loss (g/g/d)",main="")
```




```
> residPlot(lm2,main="")
```




```
> adTest(lm2$residuals)

Anderson-Darling normality test with lm2$residuals
A = 0.3881, p-value = 0.3514

> anova(lm2)

          Df Sum Sq Mean Sq F value    Pr(>F)
log.wt     1 6.5113  6.5113  140.65 1.204e-09
Residuals 17 0.7870  0.0463
Total     18 7.2983

> summary(lm2)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.73403    0.19792  -8.761 1.04e-07
log.wt      -0.33632    0.02836 -11.860 1.20e-09

Residual standard error: 0.2152 on 17 degrees of freedom
Multiple R-squared: 0.8922,Adjusted R-squared: 0.8858
F-statistic: 140.6 on 1 and 17 DF,  p-value: 1.204e-09

> confint(lm2)
```

```
                2.5 %     97.5 %
(Intercept) -2.1516113 -1.3164546
log.wt      -0.3961507 -0.2764885
> ( p.log.wtloss <- predict(lm2,data.frame(log.wt=log(5000)),interval="confidence") )
        fit       lwr       upr
1 -4.598532 -4.746569 -4.450495
> exp(p.log.wtloss)*exp(anova(lm2)[2,3]/2)
         fit         lwr        upr
1 0.01030234 0.008884726 0.01194614
```