Age-Length Key Assignment

Wolfert (1980) examined the population of Rock Bass (*Ambloplites rupestris*) from Eastern Lake Ontario in the late 1970s. In his studies, he measured the total length of 1288 Rock Bass. Scales were removed for age assignment from as many as 10 fish from each 10-mm length interval. The lengths and ages (if they existed) from all 1288 fish are recorded in `RockBassLO2.csv` [Note: the filename contains an "oh" not a "zero".].

1. Separate the observed data into age- and length-samples. How many fish are in the age-sample? How many fish are in the length-sample?

```
> setwd("C:/aaaWork/Web/fishR/Courses/MNAFS2013/CourseMaterial")
> rb <- read.csv("RockBassLO2.csv",header=TRUE)
> rb.len <- Subset(rb,is.na(age))
> rb.age <- Subset(rb,!is.na(age))
```

   There are 135 fish in the age-sample and 1153 fish in the length-sample.

2. Add a variable containing the 10-mm length categories to the age-sample (save as a new data frame). Then construct a table of the **number** (not proportion) of fish in each age and 10-mm TL category in the age sample. From these results, compute each of the following *BY HAND* (i.e., not using R).

```
> rb.age <- lencat(~tl,data=rb.age,startcat=110,w=10)
> ( tbl <- with(rb.age,table(LCat,age)) )
     age
LCat  3 4 5 6 7 8 9 10 11
  110 1 0 0 0 0 0 0  0  0
  120 1 0 0 0 0 0 0  0  0
  130 2 2 0 0 0 0 0  0  0
  140 1 9 0 0 0 0 0  0  0
  150 0 8 2 0 0 0 0  0  0
  160 0 7 2 1 0 0 0  0  0
  170 0 5 3 2 0 0 0  0  0
  180 0 4 4 1 1 0 0  0  0
  190 0 2 3 2 3 0 0  0  0
  200 0 1 2 2 4 1 0  0  0
  210 0 0 1 3 5 0 1  0  0
  220 0 0 0 3 3 2 2  0  0
  230 0 0 0 0 4 1 2  2  1
  240 0 0 0 0 1 5 2  2  0
  250 0 0 0 0 3 2 2  2  1
  260 0 0 0 0 0 1 2  1  0
  270 0 0 0 0 0 1 0  4  0
```

   (a) How many fish in the age-sample are in the 180-mm length category?
   There are 10 fish in the 180-mm TL category.

   (b) How many age-7 fish are in the age-sample?
   There are 24 age-7 fish.

   (c) What proportion of Rock Bass in the 140-mm length category are age-4?
   The proportion of 140-mm TL Rock Bass that are age-4 is $\frac{9}{10}$=0.90.

   (d) What proportion of Rock Bass in the 200-mm length category are age-8?
   The proportion of 200-mm TL Rock Bass that are age-8 is $\frac{1}{10}$=0.10.

3. Construct an age-length key from the table above (using R). From these results answer the following questions.

```
> ( ak <- prop.table(tbl,margin=1) )

     age
LCat     3    4    5    6    7    8    9   10   11
  110 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
  120 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
  130 0.50 0.50 0.00 0.00 0.00 0.00 0.00 0.00 0.00
  140 0.10 0.90 0.00 0.00 0.00 0.00 0.00 0.00 0.00
  150 0.00 0.80 0.20 0.00 0.00 0.00 0.00 0.00 0.00
  160 0.00 0.70 0.20 0.10 0.00 0.00 0.00 0.00 0.00
  170 0.00 0.50 0.30 0.20 0.00 0.00 0.00 0.00 0.00
  180 0.00 0.40 0.40 0.10 0.10 0.00 0.00 0.00 0.00
  190 0.00 0.20 0.30 0.20 0.30 0.00 0.00 0.00 0.00
  200 0.00 0.10 0.20 0.20 0.40 0.10 0.00 0.00 0.00
  210 0.00 0.00 0.10 0.30 0.50 0.00 0.10 0.00 0.00
  220 0.00 0.00 0.00 0.30 0.30 0.20 0.20 0.00 0.00
  230 0.00 0.00 0.00 0.00 0.40 0.10 0.20 0.20 0.10
  240 0.00 0.00 0.00 0.00 0.10 0.50 0.20 0.20 0.00
  250 0.00 0.00 0.00 0.00 0.30 0.20 0.20 0.20 0.10
  260 0.00 0.00 0.00 0.00 0.00 0.25 0.50 0.25 0.00
  270 0.00 0.00 0.00 0.00 0.00 0.20 0.00 0.80 0.00
```

(a) What proportion of Rock Bass in the 210-mm length category should be assigned an age of 5?
The proportion of 210-mm Rock Bass that should be assigned an age of five is 0.1.

(b) How many of thirty Rock Bass in the 180-mm length category should be assigned an age of 5?
The proportion of 180-mm Rock Bass that should be assigned an age of five is 0.4. Thus, 30∗0.4 = 12 fish should be assigned an age of five.

4. Use the semi-random age assignment technique from Isermann and Knight (2005) to assign ages to the un-aged fish in the length-sample (save as a new data frame). Combine the age-sample and the age-assigned length-sample into a single data frame. Add a variable containing the 10-mm length categories to the combined data frame. Use the combined data frame to answer the following questions.

```
> rb.len.mod <- ageKey(ak,age~tl,data=rb.len)
> rb.len.mod <- lencat(~tl,data=rb.len.mod,startcat=110,w=10)
> rb.comb <- rbind(rb.age,rb.len.mod)
```

(a) How many fish are estimated to be age-5? [Hint: use `table()` or `Summarize()`.]

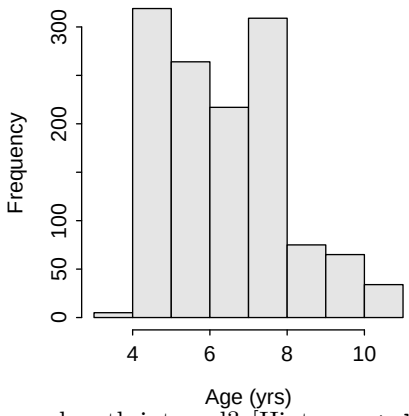
```
> ( af <- table(rb.comb$age) )

  3   4   5   6   7   8   9  10  11
  5 319 264 217 309  75  65  28   6
```

There were 264 fish estimated to be age-5.

(b) How many fish are estimated to be age-11?
There were 6 fish estimated to be age-11.

(c) Plot the age distribution for all fish.

```
> hist(~age,data=rb.comb,breaks=3:11,xlab="Age (yrs)",col="gray90")
```



(d) How many fish are in the 150-mm length interval? [Hint: use `table()`.]

```
> ( lf <- table(rb.comb$LCat) )

110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270
  1   1   4  11  43  90 134 201 200 210 151 112  59  43  19   4   5
```

There were 43 fish in the 150-mm TL interval.

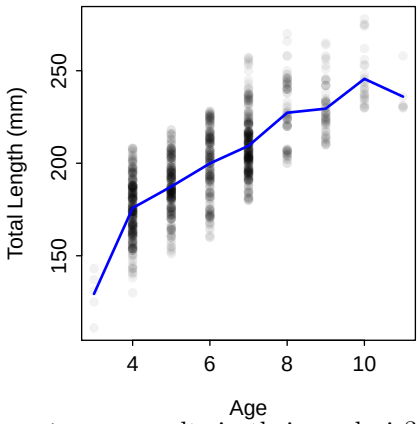
(e) What is the mean length of age-5 fish?

```
> ( sl <- Summarize(tl~age,data=rb.comb,digits=1))
Warning:  To continue, variable(s) on RHS of formula were converted to a factor.
  age   n  mean   sd min  Q1 median  Q3 max percZero
1   3   5 129.4 12.3 111 125    131 137 143        0
2   4 319 175.8 15.5 130 165    176 187 208        0
3   5 264 187.4 14.4 151 180    187 197 218        0
4   6 217 199.9 17.7 160 188    202 214 228        0
5   7 309 209.4 15.6 180 198    207 217 257        0
6   8  75 227.3 17.6 200 207    226 242 270        0
7   9  65 229.5 13.9 210 221    227 235 265        0
8  10  28 245.6 14.9 230 235    240 253 278        0
9  11   6 236.0 11.0 230 230    231 235 258        0
```

The mean length for age-5 fish is 187.4 mm.

(f) Plot the length-at-age with the mean length-at-age superimposed for all fish.

```
> plot(tl~age,data=rb.comb,ylab="Total Length (mm)",xlab="Age",pch=16,col=rgb(0,0,0,0.05))
> lines(mean~fact2num(age),data=sl,col="blue",lwd=2)
```



(g) Did your "neighbor" get the *exact* same results in their analysis? Why or why not? If not, how different were they?

The results are not exactly the same (this is easier to see in the age distribution table, rather than the plot) due to the randomization involved in handling *fractionation*. They likely did not differ much.

5. Make sure your script is "clean" (i.e., it contains no code that is superfluous or results in errors) and save it (we will use it again later in the workshop).