Mark-Recap HW #1

Young and Hayes (2001) described a study where brown trout (*Salmo trutta*) in several rivers were captured by experienced fly fishers, tagged at the base of the dorsal fin with a colored dart tag, and then observed by divers drifting through the sample area two days later. In this study on the Ugly River, 43 trout were marked, 123 fish were observed by the divers, and 16 fish observed by the divers were tagged.

a. Assign one of these symbols (N, M, n, m) to the numerical results from this study.
   The M=43, n=123, and m=16.

b. Which method (Petersen or Chapman) should be used to estimate abundance?
   The Chapman method should be used because it produces an unbiased estimate of N.

c. Use the method you chose to construct a population estimate, with 95% confidence interval, for this section of the Ugly River. State which method you used to construct the confidence interval and explain why you chose that method.

```
> mr1 <- mrClosed(M=43,n=123,m=16,type="Chapman")
> summary(mr1)

       N
[1,] 320

> confint(mr1)

     95% LCI 95% UCI
[1,]     211     493
```

   The population size (N) is estimated to be 320 with a 95% confidence interval between 211 and 493. The binomial method was used because $\frac{m}{n}$=0.13>0.10.

Mark-Recap HW #2

Warren *et al.* (2004) examined the population of rainbow trout (*Oncorhynchus mykiss*) in the Upper Niagara Springs pond in 2000. Fish were captured at two times by using an electrofishing unit attached to a driftboat. The capture history of all fish examined in the two samples is in `data(RBTroutUNSP)` in the `FSAdata` package. Analyze these capture histories to answer the following questions.

a. Create a summary of the capture histories.

```
> data(RBTroutUNSP)
> ch1 <- capHistSum(RBTroutUNSP)
> ch1$caphist


01 10 11
99 63 11
> ch1$sum
   M   n  m
1 74 110 11
```

b. From your capture history summary assign values to each of M, n, and m.
The M=74, n=110, and m=11.

c. Which method (Petersen or Chapman) is most appropriate for this study? Explain.
The Chapman method should be used because it produces an unbiased estimate of N.

d. Construct an appropriate population estimate, with a 95% confidence interval, for Upper Niagara Springs pond in 2000. State which method you used to construct the confidence interval and explain why you chose that method.

```
> mr2 <- mrClosed(ch1,type="Chapman")
> summary(mr2)
       N
[1,] 693
> confint(mr2)
     95% LCI 95% UCI
[1,]     402    1282
```

The population size (N) is estimated to be 693 with a 95% confidence interval between 402 and 1282. The Poisson method was used because $\frac{m}{n}$=$\frac{11}{110}$=0.10 is not >0.10 and m= 11<50.

Mark-Recap HW #3

Rogers (1999) reported on a study of the endangered freshwater mussel, the tan riffleshell (*Epioblasma florentina walkeri*). One part of the study included a detailed analysis of the population dynamics of mussels in a 100-m stretch of stream. In this stream, mussels were captured by teams of snorkelers on six occasions (June, 1996; August, 1996; June, 1997; October, 1998; May, 1999; and June, 1999). Mussels were tagged by superglueing a numbered tag to the left valve of the mussel. The number of mussels captured, the number of marked mussels observed, and the number of tagged mussels returned to the population was recorded for each sample time. These data are recorded in `data(Riffleshell)` in the `FSAdata` package. Use this information to construct estimates of the number of riffleshell mussels in the population at the beginning of the study and comment on the validity of the assumptions.

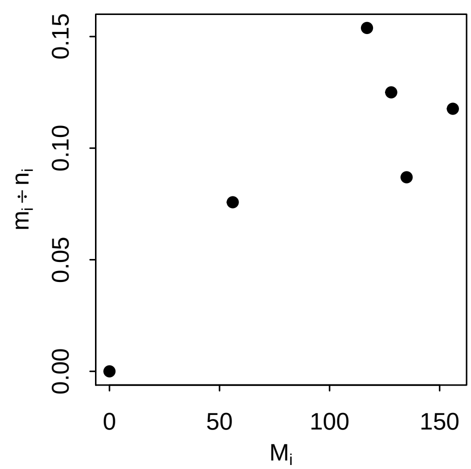
```
> data(Riffleshell)
> mr3 <- with(Riffleshell,mrClosed(M=retmarks,n=caught,m=recaps,type="Schnabel"))
> summary(mr3)

       N
[1,] 923

> confint(mr3)

     95% LCI 95% UCI
[1,]     546    1666

> plot(mr3)
```



The population size (N) is estimated to be 923 with a 95% confidence interval between 546 and 1666. The closed population assumption appears to be violated (plot is not linear), which is not a surprise given that the study took place over four years.

Mark-Recap HW #4

Mraz (1968) examined the population dynamics of young-of-the-year (YOY) walleye (*Sander vitreus*) in an inland Wisconsin lake. In fall 1962, YOY walleye were captured, marked, and returned to the lake on five sampling dates. On each date, the number of fish caught, the number of caught fish that were previously marked, and the number of marked fish returned to the lake were recorded. These results are shown in the table below. Use these data to estimate, with 95% confidence interval, the initial population size. Construct a plot and interpret the evidence for any assumption violations.

Sample	Caught	Recaptured	Returned
1	321	–	321
2	412	45	412
3	178	55	178
4	415	93	415
5	367	113	–

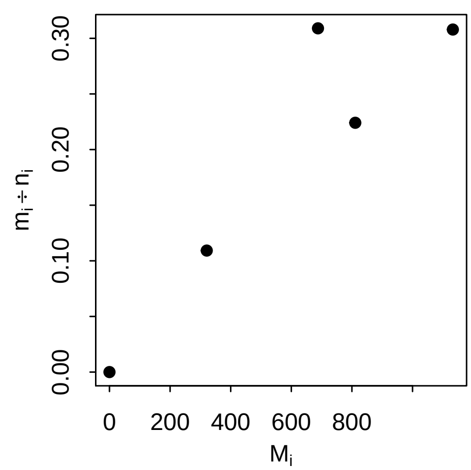
```
> n1 <- c(321,412,178,415,367)
> m1 <- c(0,45,55,93,113)
> R1 <- c(n1[1:4],0)
> mr4 <- mrClosed(n=n1,m=m1,R=R1,type="Schnabel")
> summary(mr4)

        N
[1,] 3280

> confint(mr4)

     95% LCI 95% UCI
[1,]    2776    4009

> plot(mr4)
```



The population size (N) is estimated to be 3280 with a 95% confidence interval between 2776 and 4009. The assumptions do not look grossly violated as the assumptions plot is largely linear, with the exception of one time period where more marks were captured than would be expected.

Mark-Recap HW #5

The following is a summary of the capture histories for a hypothetical collection of 100 fish. Use these results to find the summary values used in the Schnabel multiple census method (i.e., calculate n_i, m_i, R_i, and M_i for each sample). [Note: Find n_i and m_i from the summary capture histories and then use those results to find R_i and M_i.]

```
00001 00010 00011 00100 00101 00110 00111 01000 01001 01010 01011 01100
   11    12     5    14     5     2     1    15     2     2     1     2
01101 01110 10000 10001 10010 10100 10110 11000 11010 11011 11111
    1     1     4     4     7     6     1     1     1     1     1
```

```
> ch <- c("00001;","00010;","00011;","00100;","00101;","00110;","00111;","01000;","01001;",
         "01010;","01011;","01100;","01101;","01110;","10000;","10001;","10010;","10100;",
         "10110;","11000;","11010;","11011;","11111;")
> freq <- c(11,12,5,14,5,2,1,15,2,2,1,2,1,1,4,4,7,6,1,1,1,1,1)
> df <- data.frame(ch,freq)
> df1 <- capHistConvert(df,mch="ch",freq="freq",in.type="MARK",out.type="FSA")
> ch1 <- capHistSum(df1)
> ch1$sum
```

```
   n  m  R  M
1 26  0 26  0
2 28  4 28 26
3 34 12 34 50
4 35 18 35 72
5 32 21  0 89
```