1 R Terminology Assignment

1. Load the data in the **RuffeBio.csv** file into a data frame in R.

   (a) How many variables are in this data frame?
   (b) Data was recorded for how many ruffe in this data frame?
   (c) What R data type is *tl*?
   (d) What R data type is *maturity*?
   (e) What is the *tl* for the 17th measured individual?

2. For each situation below, create a new data frame (from the original) and record how many fish are in that data frame.

   (a) Just female ruffe.
   (b) Just ruffe with a total length greater than 110 mm.
   (c) Just ruffe with a total length between 80 and 110 mm.
   (d) Excluding all fish of an "unknown" sex.

3. Create new variables in the original data frame for the following situations.

   (a) Fulton's condition factor (The weight of the fish divided by the cubed length of the fish multiplied by 10000).

4. If you have time ...

   (a) Create a length variable that is the total length in inches.
   (b) Create a subset of just male ruffe with a total length less than 80 mm.
   (c) What is the *tl* for all but the 10th individual?
   (d) Show all recorded information for the 11th individual.

2 R Summarization Assignment

1. Load the data in the **LakeTroutALTER.csv** file into a data frame in R.
   (a) How many variables are in this data frame?
   (b) Data was recorded for how many lake trout?
   (c) What R data type is *age*?
   (d) What R data type is *sex*?

2. Summarize age in the following ways:
   (a) Construct age-frequency (number-at-age) and age-percentage (percentage-at-age) tables.
   (b) Construct a bar chart of the age-percentage table.
   (c) Construct an age-percentage table separated by sex (e.g., what percentage of males were age-17?).

3. Summarize total length in the following ways:
   (a) Compute summary statistics of total length for all fish.
   (b) Construct a histogram of total length using 50-mm length increments
   (c) Compute summary statistics of total length separately for each age.
   (d) Construct a bar plot of mean length-at-age.

4. Examine the following relationships (graphically and, if appropriate, numerically):
   (a) Between total length and weight.
   (b) Between total length and otolith radius.

5. If you have time ...
   (a) Compute summary statistics of total length separated by sex of the fish.
   (b) Construct separate histograms of total length for males and females.
   (c) Examine the relationship between age and total length.
   (d) Examine the relationship between age and total length with separate symbols for different sexes.

3 R Size Structure Assignment

1. Load the data in the **Lab1a.csv** file into a data frame in R (this is the same data used in the handout).

2. Compute the PSD value for walleye.

3. Compute the PSD value for yellow perch.

4. Construct a tic-tac-toe graph with a point for walleye and yellow perch on it.

5. If you have time ...

   (a) Compute the RSD-500 for walleye.

   (b) Construct a tic-tac-toe graph with two points – one for walleye and yellow perch and one for largemouth bass and bluegill. [Note: you can copy the code for the largemouth bass and bluegill from the handout.]

4 R Catch Curve Assignment

1. The population biology of Lake Superior lake trout prior to 1950 was examined in detail by Sakagawa and Pycha (1971). In Table 1 of their paper, they presented the number of lake trout in each age-group collected in 4.5-inch mesh gillnets between the Keweenaw Peninsula and Munising, MI in 1948. The numbers caught for age-III to age-XIV lake trout was 5, 18, 21, 10, 45, 109, 95, 63, 42, 25, 13, and 4. Use these data to answer the questions below.

   (a) Enter the data into vectors and then combine into a data frame.

   (b) Plot log(catch) versus age. Which ages best represent the descending portion of the catch-curve?

   (c) Fit the linear model required to estimate instantaneous total mortality to these data with `lm()`. What is the estimate, with confidence interval, of the instantaneous total mortality rate?

   (d) Find the instantaneous total mortality rate using `catchCurve()`. Do these results match your results in the previous question?

2. **If you have time ...** Curtis (1990) examined the population dynamics related to the recovery of an offshore lake trout population near Stannard Rock, Lake Superior. As part of his study he estimated the mortality rates from the relative abundance of lake trout greater than 43.2 cm long. Relative abundance was recorded as the CPE of each age group in each year expressed as the number of fish caught per 50,000 m of 114.3-mm-mesh gill net. The results are shown in the table below. Use these results to answer the following questions. Note: (1) the values in the table have been rounded to integers; values recorded as "tr" in the original paper were recorded as "0.5" in this table; and (2) the years of capture are not contiguous (there is a break between 1959 and 1963 and again between 1969 and 1973).

Capture	Age-Group								
Year	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
1959	64	219	241	121	33	9	1	0.5	1
1963	129	339	331	192	70	16	0.5	0.5	0.5
1964	149	524	515	201	63	18	2	0.5	0.5
1965	75	379	501	328	133	39	11	1	0.5
1966	149	488	459	172	64	22	5	0.5	0.5
1967	63	368	287	130	55	19	6	0.5	0.5
1968	50	215	259	141	55	18	5	1	0.5
1969	45	150	153	76	23	6	0.5	0.5	0.5
1973	101	759	1268	1116	491	141	40	4	0.5
1974	151	733	1114	1092	571	163	50	9	5
1975	109	901	1517	1606	1076	342	117	12	7
1976	53	604	1204	1560	1146	396	156	18	10
1977	157	867	1343	1410	1031	417	192	17	7
1978	89	735	1307	1623	1150	445	198	18	14
1979	29	299	718	1268	1195	585	300	36	14

   (a) Estimate, with 95% confidence interval, the instantaneous total mortality rate of fish caught in 1963. Describe which ages of fish you used to make your estimate and why you chose those ages.

   (b) Estimate, with 95% confidence interval, the instantaneous total mortality rate for fish of the 1963 year-class. Describe which ages of fish you used to make your estimate and why you chose those ages.

5 R Growth Assignment

1. The length and otolith age of sculpins captured in the Arctic Long-Term Ecological Research area were recorded in **SculpinALTER.csv**. Use the total length and age data to answer the following questions.

   (a) Load these data into an R data frame.

   (b) Compute estimates for the three parameters of a "traditional" von Bertalanffy growth model.

   (c) Construct a plot of length versus age with the best-fit von Bertalanffy growth model superimposed.

2. If you have time ...

   (a) Compute estimates for the three parameters of a "Galucci and Quinn" parameterization of the von Bertalanffy growth model.

   (b) Construct a length-weight regression model for these sculpins.

6 R Mark-Recapture Assignment

1. Warren *et al.* (2004) examined the population of rainbow trout 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 histories of all fish examined in the two samples are recorded in **RBTroutUNSP.csv**. Load these data into a data frame in R and answer the following questions.

   (a) Create a summary of the capture histories.

   (b) From your capture history summary assign values to each of these symbols (M, n, m).

   (c) Construct an appropriate population estimate, with a 95% confidence interval, for Upper Niagara Springs pond in 2000.

2. Mraz (1968) examined the population dynamics of young-of-the-year (YOY) walleye 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 with the Schnabel method. Construct a plot and interpret the evidence for any assumption violations.

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