

```
> library(FSA)
```

Talcot Lake (MN) Black Crappie

```
> setwd("C:/aaaWork/Web/fishR/courses/MNAFS2013/CourseMaterial/")
> df <- read.csv("MNBCData.csv",header=TRUE)
> str(df)

'data.frame': 357 obs. of 20 variables:
 $ species: Factor w/ 6 levels "BLC","BLG","NOP",...: 1 1 1 1 1 1 1 1 1 1 ...
 $ gear   : Factor w/ 4 levels "GN","GN, TN",...: 4 4 4 4 4 4 4 2 2 ...
 $ lake   : Factor w/ 7 levels "Benton","Bingham",...: 1 1 1 1 1 1 2 2 5 5 ...
 $ yearcap: int 2006 2006 2006 2006 2006 2006 2006 2006 2006 2006 ...
 $ fish   : int 67 43 45 44 42 41 63 78 56 55 ...
 $ agecap : int 1 2 4 4 4 4 4 1 1 ...
 $ lencap : int 108 198 258 247 249 235 278 284 135 127 ...
 $ anu1    : num 1.15 1.42 1.52 1.28 1.43 ...
 $ anu2    : num 2.28 3.06 3.28 3.35 2.53 ...
 $ anu3    : num NA 3.88 4.27 3.86 3.36 ...
 $ anu4    : num NA NA 4.88 4.11 3.68 ...
 $ anu5    : num NA NA 5.66 4.34 3.99 ...
 $ anu6    : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu7    : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu8    : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu9    : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu10   : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu11   : num NA NA NA NA NA NA NA NA NA NA ...
 $ anu12   : num NA NA NA NA NA NA NA NA NA NA ...
 $ radcap  : num 2.28 3.88 5.66 4.34 3.99 ...

> levels(df$species)
[1] "BLC" "BLG" "NOP" "PMK" "WAE" "YEP"

> blcT <- Subset(df,species=="BLC" & lake=="Talcot")
> view(blcT)
```

	species	gear	lake	yearcap	fish	agecap	lencap	anu1	anu2	anu3	anu4	anu5
91	BLC	TN	Talcot	2006	33	2	211	0.980	2.927	4.246	NA	NA
94	BLC	TN	Talcot	2006	67	2	211	1.005	3.078	4.259	NA	NA
109	BLC	TN	Talcot	2006	147	3	243	1.297	3.728	4.597	4.887	NA
114	BLC	TN	Talcot	2006	64	4	263	1.146	2.972	4.219	4.824	5.013
115	BLC	TN	Talcot	2006	79	4	262	1.549	3.866	4.660	5.290	5.567
121	BLC	TN	Talcot	2006	80	5	290	1.315	2.710	3.447	4.229	4.819
	anu6	anu7	anu8	anu9	anu10	anu11	anu12	radcap				
91	NA	NA	NA	NA	NA	NA	NA	4.246				
94	NA	NA	NA	NA	NA	NA	NA	4.259				
109	NA	NA	NA	NA	NA	NA	NA	4.887				
114	NA	NA	NA	NA	NA	NA	NA	5.013				
115	NA	NA	NA	NA	NA	NA	NA	5.567				
121	5.023	NA	NA	NA	NA	NA	NA	5.023				

Scale-Length and Length-Scale Relationships

```
> lm.SL <- lm(radcap~lencap,data=blcT)
> coef(lm.SL)

(Intercept)      lencap
    0.19409      0.01823

> ( a <- coef(lm.SL)[1] )

(Intercept)
    0.1941

> ( b <- coef(lm.SL)[2] )

lencap
0.01823

> lm.LS <- lm(lencap~radcap,data=blcT)
> coef(lm.LS)

(Intercept)      radcap
    0.6827      51.9323

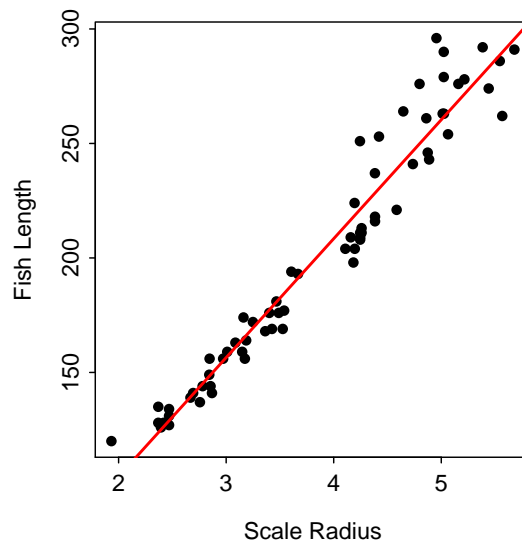
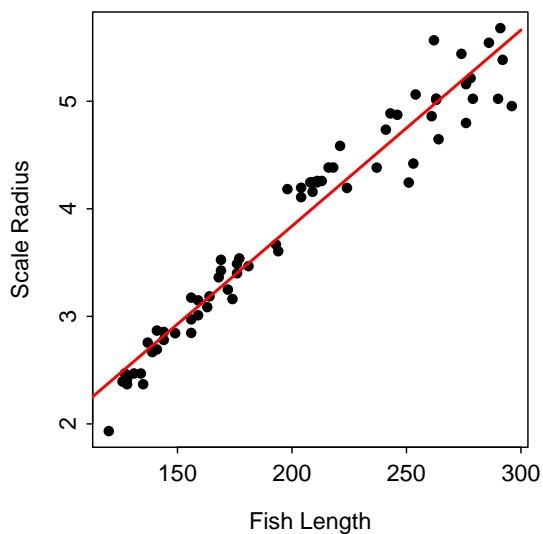
> ( c <- coef(lm.LS)[1] )

(Intercept)
    0.6827

> ( d <- coef(lm.LS)[2] )

radcap
51.93
```

```
> plot(radcap~lencap,data=blcT,ylab="Scale Radius",xlab="Fish Length",pch=16) # Left
> curve(a+b*x,from=110,to=300,col="red",lwd=2,add=TRUE)
> plot(lencap~radcap,data=blcT,ylab="Fish Length",xlab="Scale Radius",pch=16) # Right
> curve(c+d*x,from=1.8,to=6,col="red",lwd=2,add=TRUE)
```



Reshape to One-Measurement-Per-Line Format

```
> blcT2 <- gReshape(blct, in.pre="anu", last.plus="agecap")
> str(blct2)

'data.frame': 149 obs. of 10 variables:
 $ species: Factor w/ 1 level "BLC": 1 1 1 1 1 1 1 1 1 1 ...
 $ gear   : Factor w/ 1 level "TN": 1 1 1 1 1 1 1 1 1 1 ...
 $ lake   : Factor w/ 1 level "Talcot": 1 1 1 1 1 1 1 1 1 1 ...
 $ yearcap: int 2006 2006 2006 2006 2006 2006 2006 2006 2006 2006 ...
 $ fish   : int 131 130 129 53 52 51 50 49 48 47 ...
 $ agecap : int 1 1 1 1 1 1 1 1 1 1 ...
 $ lencap : int 176 177 176 135 141 163 156 137 144 156 ...
 $ radcap : num 3.49 3.54 3.4 2.37 2.87 ...
 $ age    : int 1 1 1 1 1 1 1 1 1 1 ...
 $ anu    : num 1.93 1.74 1.79 1.17 1.3 ...

> view(blct2)
```

	species	gear	lake	yearcap	fish	agecap	lencap	radcap	age	anu
8	BLC	TN	Talcot	2006	49	1	137	2.756	1	1.309
19	BLC	TN	Talcot	2006	38	1	168	3.363	1	1.763
32	BLC	TN	Talcot	2006	128	2	198	4.183	1	1.018
117	BLC	TN	Talcot	2006	31	3	253	4.421	2	2.985
132	BLC	TN	Talcot	2006	80	5	290	5.023	2	2.710
198	BLC	TN	Talcot	2006	32	5	274	5.441	3	4.055

Fraser-Lee Back-Calculation

```
> blcT2 <- within(blct2, lenFL <- (anu/radcap)*(lencap-c)+c)
> view(blct2)
```

	species	gear	lake	yearcap	fish	agecap	lencap	radcap	age	anu	lenFL
37	BLC	TN	Talcot	2006	67	2	211	4.259	1	1.005	50.31
47	BLC	TN	Talcot	2006	144	2	194	3.606	1	0.653	35.69
106	BLC	TN	Talcot	2006	66	2	221	4.585	2	3.342	161.27
109	BLC	TN	Talcot	2006	62	2	204	4.196	2	3.116	151.67
123	BLC	TN	Talcot	2006	126	4	276	4.798	2	3.627	208.81
262	BLC	TN	Talcot	2006	79	4	262	5.567	4	5.290	249.00

Scale Proportional Hypothesis (SPH) Back-Calculation

```
> blcT2 <- within(blct2, lenSPH <- (anu/radcap)*(lencap+(a/b))-(a/b))
> view(blct2)
```

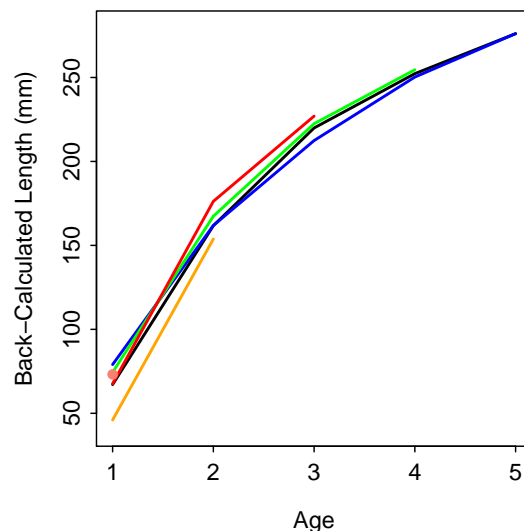
	species	gear	lake	yearcap	fish	agecap	lencap	radcap	age	anu	lenFL	lenSPH
8	BLC	TN	Talcot	2006	49	1	137	2.756	1	1.309	65.43	59.48
31	BLC	TN	Talcot	2006	149	1	128	2.369	1	1.047	56.95	50.63
45	BLC	TN	Talcot	2006	77	2	218	4.384	1	0.980	49.26	40.46
60	BLC	TN	Talcot	2006	142	4	286	5.544	1	1.417	73.61	65.17
102	BLC	TN	Talcot	2006	33	2	211	4.246	2	2.927	145.67	142.15
267	BLC	TN	Talcot	2006	30	5	279	5.023	4	4.422	245.70	244.34

Summaries of Back-Calculated Lengths

```
> ( sum1 <- Summarize(lenFL~age,data=blcT2,digits=2) )
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   1 68  67.12 16.36  35.7  55.1    67  80.8  97.5        0
2   2 37 161.74 17.35 121.0 153.0   158 173.0 209.0        0
3   3 21 219.94 13.23 195.0 214.0   220 229.0 246.0        0
4   4 15 252.28  9.34 242.0 245.0   249 258.0 271.0        0
5   5  8 276.10  8.45 265.0 270.0   275 284.0 287.0        0

> ( sum2 <- Summarize(lenFL~age*agecap,data=blcT2,digits=2) )
Warning: To continue, variable(s) on RHS of formula were converted to a factor.
  age agecap n   mean   sd   min   Q1 median   Q3   max percZero
1   1      1 1 31  73.18 13.55  47.0  62.6   71.5  83.5  97.5        0
2   1      2 1 16  46.04  7.00  35.7  39.8   46.5  49.5  59.7        0
3   2      2 1 16 153.79 14.80 121.0 150.0 153.0 156.0 189.0        0
4   1      3 1  6  67.64 11.01  53.7  61.0   66.6  72.9  84.8        0
5   2      3 1  6 176.23 14.78 159.0 165.0 176.0 184.0 198.0        0
6   3      3 1  6 227.00  4.83 220.0 225.0 227.0 228.0 235.0        0
7   1      4 1  7  74.44  9.61  60.6  71.3   73.6  75.9  92.4        0
8   2      4 1  7 167.36 21.56 144.0 157.0 160.0 172.0 209.0        0
9   3      4 1  7 222.47 10.48 214.0 218.0 219.0 220.0 246.0        0
10  4      4 1  7 254.58  9.82 245.0 248.0 250.0 260.0 271.0        0
11  1      5 1  8  79.03 10.51  65.2  71.0   80.0  85.4  94.4        0
12  2      5 1  8 161.86 13.00 141.0 154.0 161.0 174.0 178.0        0
13  3      5 1  8 212.43 16.60 195.0 198.0 207.0 230.0 234.0        0
14  4      5 1  8 250.26  9.04 242.0 244.0 246.0 255.0 266.0        0
15  5      5 1  8 276.10  8.45 265.0 270.0 275.0 284.0 287.0        0
```

```
> plot(mean~fact2num(age),data=sum1,type="l",lwd=2,ylim=c(40,280),
       ylab="Back-Calculated Length (mm)",xlab="Age")
> lines(mean~fact2num(age),data=Subset(sum2,agecap==5),lwd=2,col="blue")
> lines(mean~fact2num(age),data=Subset(sum2,agecap==4),lwd=2,col="green")
> lines(mean~fact2num(age),data=Subset(sum2,agecap==3),lwd=2,col="red")
> lines(mean~fact2num(age),data=Subset(sum2,agecap==2),lwd=2,col="orange")
> points(mean~fact2num(age),data=Subset(sum2,agecap==1),pch=16,col="salmon")
```



```

> sumTable(lenFL~agecap*age,data=blcT2,digits=2)
Warning:  RHS variable was converted to a factor.
Warning:  RHS column variable was converted to a factor.

```

	1	2	3	4	5
1	73.18	NA	NA	NA	NA
2	46.04	153.8	NA	NA	NA
3	67.64	176.2	227.0	NA	NA
4	74.44	167.4	222.5	254.6	NA
5	79.03	161.9	212.4	250.3	276.1