Professor's Notes About 2-Way ANOVA Homework 2

- The key is to construct a table of means similar to Table 1. Then $SS_{instructor}$, SS_{method} and SS_{among} are computed by following the SS_{row}, SS_{column} and SS_{among} formulas from the book. The $SS_{interaction}$ is then found from these SS and SS_{total} by subtraction. The SS_{within} is found by substracting SS_{among} from SS_{total}. All degrees-of-freedom are found by formulae in the book and realizing that $r = 2$, $c = 2$ and $n = 25$ (remember that n is the number of replicates per treatment in a two-way ANOVA, not the total number of individuals). The MS, F (but note that the denominator is always MS_{within}), and p-values are found as usual. I did this in R just for fun (you did not have to).

Table 1. Means table for cattail data.

	2015	2016	mean
far	75.45	83.98	79.72
near	74.46	80.70	77.58
mean	74.95	82.34	78.65

ANOVA Table

Results shown in Table 2. R code to make calculations are shown in an appendix (note, however, that you are not expected to make these calculations in R).

Table 2. Completed analysis of variance table for cattail data.

	df	SS	MS	F	p
Among	3	1510.2	503.4	2.58	0.058
Habitat	1	114.0	114.0	0.58	0.446
Year	1	1363.5	1363.5	6.99	0.010
Interaction	1	32.8	32.8	0.17	0.683
Within	96	18717.1	195.0		
Total	99	20227.3			

R Appendix

```r
tmns <- matrix(c(75.45,83.98,74.46,80.70),byrow=TRUE,nrow=2)
rownames(tmns) <- c("far","near")
colnames(tmns) <- c("2015","2016")
mns <- addmargins(tmns,FUN=mean)
r <- c <- 2
n <- 25
ssins <- r*n*sum((mns[1:2,3]-mns[3,3])^2)
ssmeth <- r*n*sum((mns[3,1:2]-mns[3,3])^2)
ssamong <- n*sum((mns[1:2,1:2]-mns[3,3])^2)
ssint <- ssamong-ssins-ssmeth
sstotal <- 20227.3
sswithin <- sstotal-ssamong
dfamong <- r*c-1
dfins <- r-1
dfmeth <- c-1
dfint <- dfamong-dfins-dfmeth
dftotal <- r*c*n-1
dfwithin <- dftotal-dfamong
ss <- c(ssamong,ssins,ssmeth,ssint,sswithin)
df <- c(dfamong,dfins,dfmeth,dfint,dfwithin)
ms <- ss/df
f <- ms[-length(ms)]/ms[length(ms)]
p <- round(pf(f,df1=df[-length(df)],df2=df[length(df)],lower.tail=FALSE),3)
tbl <- cbind(c(df,dftotal),c(ss,sstotal),c(ms,NA),c(f,NA,NA),c(p,NA,NA))
colnames(tbl) <- c("df","SS","MS","F","p")
rownames(tbl) <- c("Among","Habitat","Year","Interaction","Within","Total")
tbl
```