

Question 2.1 (6 pts)

a. Table below

Source	df	SS	MS	F	p-value
Among Groups	7	35819	5117	3.5	0.0099
Within Groups	24	35088	1462		
Total	31	70907			

df_{among} and SS_{among} come from subtracting the within value from the total value. MS_{among} comes from SS_{among} divide by df_{among} . F is then MS_{among} divided by MS_{within} . Finally the p-value comes from `distrib(3.5,distrib="f",df1=7,df2=24,lower.tail=FALSE)`.

- b. The number of groups = $7+1 = 8$ (i.e., $df_{among}+1$).
 c. The number of individuals = $31+1 = 32$ (i.e., $df_{total}+1$).
 d. The variability among individuals within groups is $s_p^2 = MS_{within} = 1462$.
 e. The variability among individuals ignoring groups is $s^2 = MS_{total} = \frac{70907}{31} = 2287.3$.
 f. Yes, there is a difference among the group means because the p-value is less than 0.05.

Question 2.2 (6 pts)

a. Table below

Source	df	SS	MS	F	p-value
Among Groups	3	17.25	5.75	1.26	0.3149
Within Groups	20	91.20	4.56		
Total	23	108.45			

MS_{among} comes from multiplying F and MS_{within} . df_{among} then comes from dividing SS_{among} by MS_{among} . df_{within} then comes from $df_{total}-df_{among}$. SS_{within} is then MS_{within} times df_{within} . SS_{total} is then $SS_{among} + SS_{within}$. Finally the p-value comes from `distrib(1.26,distrib="f",df1=3,df2=20,lower.tail=FALSE)`.

- b. The number of groups = $3+1 = 4$ (i.e., $df_{among}+1$).
 c. The number of individuals = $23+1 = 24$ (i.e., $df_{total}+1$).
 d. The variability among individuals within groups is $s_p^2 = MS_{within} = 4.56$.
 e. The variability among individuals ignoring groups is $s^2 = MS_{total} = \frac{108.45}{23} = 4.72$.
 f. No there is not a difference among the group means because the p-value is greater than 0.05.

Question 2.3 (3 pts)

a. Table below

Source	df	SS	MS	F	p-value
Among Groups	5	887.05	177.41	5.25	0.0006
Within Groups	48	1621.44	33.78		
Total	53	2508.49	47.33		

Note that MS_{total} and MS_{within} were given by definition. The df_{among} and df_{total} were given by knowing the number of groups and total number of individuals. The SS are then obtained, the final MS , and the F . The p-value is computed with `distrib(5.25,distrib="f",df1=5,df2=48,lower.tail=FALSE)`

- b. Yes, there is a difference among the group means because the p-value is less than 0.05.