On the last exam, we investigated sound pressure level in dB vs. sugar consumption in maniacal young children. One of your colleagues suggested a very clever algorithm for a controlled experiment in which each test subject (i.e., maniacal child) is dosed with specific levels of sugar and SPL measured; when replicated in several kids, this becomes an ANOVA problem! For several different levels of sugar, represented by careful snack selection, SPL was measured and the results presented below:

Sugar (g)	SPL (dB)			Totals	Averages
	Child 1	Child 2	Child 3		
0	56	58	49	163	54.33
4.4	71	62	88	221	73.67
9	84	64	72	220	73.33
12	68	78	91	237	79
14	74	94	77	245	81.67
19	90	102	100	292	97.33
				1378	76.56

$$\sum_{i=1}^{a}\sum_{j=1}^{n} y_{ij}^2 = 109600$$

$$a = 6$$
$$n = 3$$
$$N = 18$$

First, test the null hypothesis that the treatment means are equal at the $\alpha = 0.05$ level of significance.   Fill in the ANOVA table.

(+1) filling in table

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	f_0
Treatments	2929	5	585.8	5.972
Error	1177	12	98.08	-
Total	4106	17	-	-

$$SS_T = 109600 - \frac{1378^2}{18} = 4106 \ \text{(+1)}$$

$$SS_{Tr} = \frac{163^2 + 221^2 + 220^2 + 237^2 + 245^2 + 292^2}{3} - \frac{1378^2}{18} = 2929 \ \text{(+1)}$$

$$SS_E = 4106 - 2929 = 1177 \ \text{(+1)}$$

$$d.o.f._T = 6 \cdot 3 - 1 = 17 \ \text{(+1)}$$

$$d.o.f._{Tr} = 6 - 1 = 5 \ \text{(+1)}$$

$$d.o.f._E = 6 \cdot 2 = 12 \ \text{(+1)}$$

$$MS_{Tr} = \frac{2929}{5} = 585.8 \ \text{(+1)}$$

$$MS_E = \frac{1177}{12} = 98.08 \ \text{(+1)}$$

$$f_0 = \frac{585.8}{98.08} = 5.972 \ \text{(+1)}$$

$$f_{crit.} = f_{.05,5,12} = 3.11 \ \text{(+1)}$$

$$f_0 > f_{crit.}; \ \therefore \ \text{reject } H_0 \text{ that treatment means are equal} \ \text{(+2)}$$

Use Fisher's Least Significant Difference to determine which, if any, pairs of sugar dosing significantly affects sound pressure level at $\alpha = 0.05$. Hint: there are 15 pairs. (Relax, it won't take you very long to list them if you do it like I did in lecture.)

$$t_{.025,\,12} = 2.179 \quad \Rightarrow \quad LSD = 2.179\sqrt{\frac{2 \cdot 98.08}{3}} = 17.62$$

(+1)   (+1)

0 vs. 4.4 : $|54.33 - 73.67| = 19.34 > LSD$ ← these pairs show significar

4.4 vs. 9 : $|73.67 - 73.33| = 0.34$

(+2)

9 vs. 12 : $|73.33 - 79| = 5.67$

12 vs. 14 : $|79 - 81.67| = 2.67$ pairs listed (+2)

14 vs. 19 : $|81.67 - 97.33| = 15.66$

differences computed (+2)

0 vs. 9 : $|54.33 - 73.33| = 19 > LSD$ ←

4.4 vs. 12 : $|73.67 - 79| = 5.33$

9 vs. 14 : $|73.33 - 81.67| = 8.34$

12 vs. 19 : $|79 - 97.33| = 18.33 > LSD$ ←

0 vs. 12 : $|54.33 - 79| = 24.67 > LSD$ ←

4.4 vs. 14 : $|73.67 - 81.67| = 8$

9 vs. 19 : $|73.33 - 97.33| = 24 > LSD$ ←

0 vs. 14 : $|54.33 - 81.67| = 27.34 > LSD$ ←

4.4 vs. 19 : $|73.67 - 97.33| = 23.66 > LSD$ ←

0 vs. 19 : $|54.33 - 97.33| = 43 > LSD$ ←