New York University Tandon School of Engineering

Biomedical Engineering
Applied Mathematics and Statistics for Biomedical Engineering

Fall 2021
Professor Mirella Altoe
Tuesday 5:00-7:30PM Rogers Hall 325

Computer Lab Assignment #9

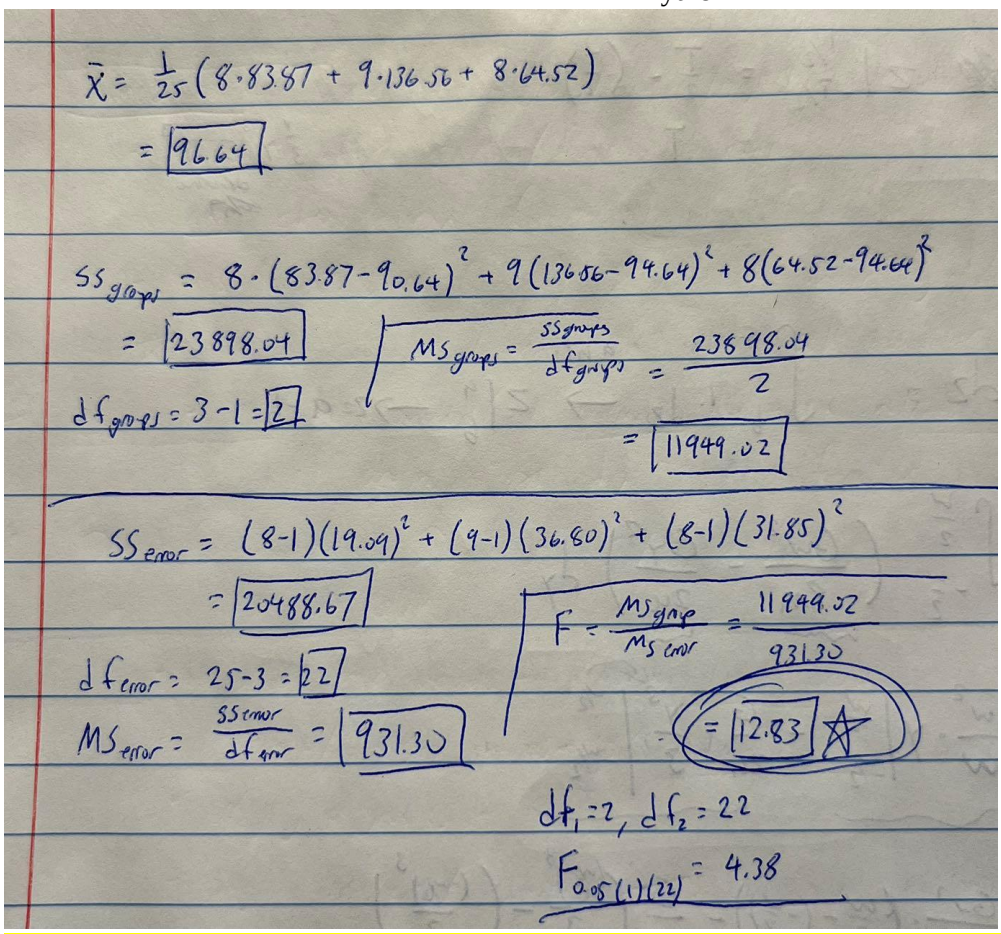
QUESTION 1: In some animal species, exposure to males reduces lifespan of females, because of the damage caused by harassment and male seminal fluids. In other species, exposure to other females is more harmful than exposure to males because of resource competition or aggressive interactions between females. Khan et al. (2018) tested these effects in the flour beetle *Tribolium castaneum*, whose females are known to produce toxins called quinones that may affect other individuals. They created groups of beetles that had equal numbers of males and females ("unbiased" sex ratio), more males than females ("male-biased"), or more females than males ("female-biased"). They measured the number of offspring per female in each group.

Unbiased: 82.16 , 62.16 , 79.83 , 82.33 , 75.83 , 127.33 , 87.16 , 74.16
Male-biased: 118 , 87 , 123 , 150 , 94 , 133 , 206 , 162 , 156
Female-biased: 80.16 , 6 , 53.17 , 121.34 , 69 , 57.82 , 62.16 , 66.5

A. **(2.0 pts.)** Use ANOVA to test whether the sex ratio treatment affects the mean number of offspring per female.

	Mean	Stdev	Count
Unbiased	83.870000	19.091744	8
Male_Biased	136.555556	36.803910	9
Fem_Biased	64.518750	31.850062	8

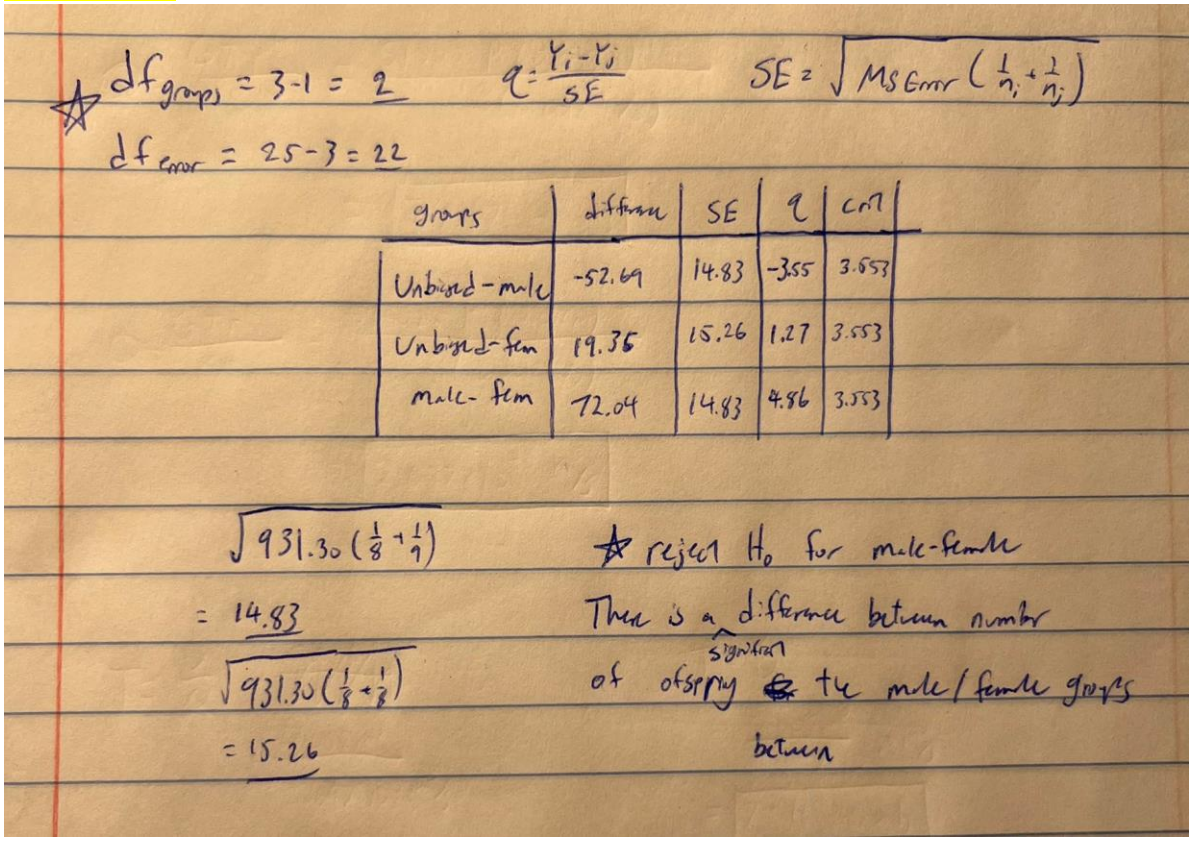
←Python



Since our calculated test statistic of 12.83 is greater than the critical value of 4.38, we can reject H_0. Number of offspring is associated with sex ratio (at least one of our three pairs differ).

B. (2.0 pts.) Determine which of the three treatment means are different from the others.

Handwritten:



$df_{groups} = 3-1 = 2$ $\quad q = \frac{Y_i - Y_j}{SE}$ $\quad SE = \sqrt{MS_{Error}\left(\frac{1}{n_i} + \frac{1}{n_j}\right)}$

$df_{error} = 25-3 = 22$

groups	difference	SE	q	crit
Unbiased-male	-52.69	14.83	-3.55	3.553
Unbiased-fem	19.35	15.26	1.27	3.553
male-fem	72.04	14.83	4.86	3.553

$\sqrt{931.30\left(\frac{1}{8} + \frac{1}{9}\right)}$

$= 14.83$

$\sqrt{931.30\left(\frac{1}{8} + \frac{1}{8}\right)}$

$= 15.26$

reject H_0 for male-female

There is a significant difference between number of offspring ~~&~~ the male/female groups between

Python:

	group1	group2	Diff	Lower	Upper	q-value	p-value
0	Unbiased	Male-Bias	52.685556	15.444572	89.926539	5.024615	0.004864
1	Unbiased	Fem-Bias	19.351250	-18.969406	57.671906	1.793529	0.429012
2	Male-Bias	Fem-Bias	72.036806	34.795822	109.277789	6.870142	0.001000

We can reject H_0 for the unbiased-male, and male-female groups. There is a significant difference between the mean number of offspring between each of these two groups.