Activity 2.2: Comparing Treatment Means
Fruit Flies

> **i** Note
>
> Submit via Gradescope, don't forget to assign pages to the questions in the outline!

Scientists are interested in whether the energy costs of reproduction affect longevity in male fruit flies.

In this experiment:

- 125 male fruit flies were randomly assigned to 5 treatment groups (25 flies per group).

- Males were housed individually.

- The treatments differed by the number and type of female companions provided per day:

Companion	Description
1P $(i = 1)$	One pregnant female
8P $(i = 2)$	Eight pregnant female
1V $(i = 3)$	One virgin females
8V $(i = 4)$	Eight virgin female
None $(i = 5)$	No female companions

The response variable was longevity (days alive) for each male fruit fly.

The data are provided in `02_fruitfly_data.csv` on Canvas.

⚠ If using R, make sure to set your "sum to zero" constraint *before* fitting your model with `lm()`.

a. Skeleton ANOVA

Fill out the skeleton ANOVA according to the study.

Source of Variation (SV)	DF (total = _____)

b. Overall ANOVA F-test

Run an ANOVA in JMP/R to assess whether any differences in mean longevity exist among the treatments. *Get in the habit of checking your model assumptions – residual vs fitted & qq-plots.*

- Complete the hypotheses using notation:

  - H_0:

  - H_A :

- Write your conclusion in context including all evidence (F = ; df = ; p =).

c. Least Squares Means

Use JMP/R to obtain the estimated mean longevity and standard error for each treatment. Create a plot of the least square means (look at it!).

Companion	LSMean	Standard Error
1P	$\hat{\mu}_1 =$	
8P	$\hat{\mu}_2 =$	
1V	$\hat{\mu}_3 =$	
8V	$\hat{\mu}_4 =$	
None	$\hat{\mu}_5 =$	

d. Interpret Estimated Means

Using the estimated parameters / coefficients (e.g., $\hat{\mu}$, $\hat{\tau}_1$, $\hat{\sigma}^2$), show by hand how $\hat{\mu}_1$ and $SE(\hat{\mu}_1)$ is obtained. Interpret these values in context of the problem.

- $\hat{\mu}_1 =$

- $SE(\hat{\mu}_1) =$

- Interpretation:

e. Planned Contrast 1: Any Females vs No Females

Scientists are interested in whether exposure to any females affects longevity.

- Write the Contrast:
- Using JMP/R, carry out the test and provide the following in context of the problem:

    - Interpret the estimated mean:

    - Interpret the confidence interval:

    - Provide a conclusion for the test (include all evidence – t = , df = , p =):

f. Pairwise Comparisons

Scientists also want to know which specific treatments differ from each other.

Perform all pairwise comparisons using *no* adjustment (i.e., Fishers LSD) and *Tukey's* adjustment. Provide the p-value for each pairwise comparison in the table below.

Comparison (e.g. 1P - 1V)	Estimate	Unadjusted p-value	Adjusted p-value Tukey)

- How do the *unadjusted* and *adjusted* p-values compare?

g. Tukey Letter Groupings

Using the *Tukey* pairwise comparisons in (f) and your table of estimated means in (c), fill out the compact letter display table below. *Note: you can check your answers in JMP/R.*

Companions	LSMean	Group

h. (Optional) Extra practice with contrasts

Identify the contrast coefficients for the following comparisons. Can you test these in R/JMP? How are they tested by hand?

Comparison	1P	8P	1V	8V	None
Any Companion vs None					
Exposure to one female vs eight females					
One virgin female vs eight virgin females					