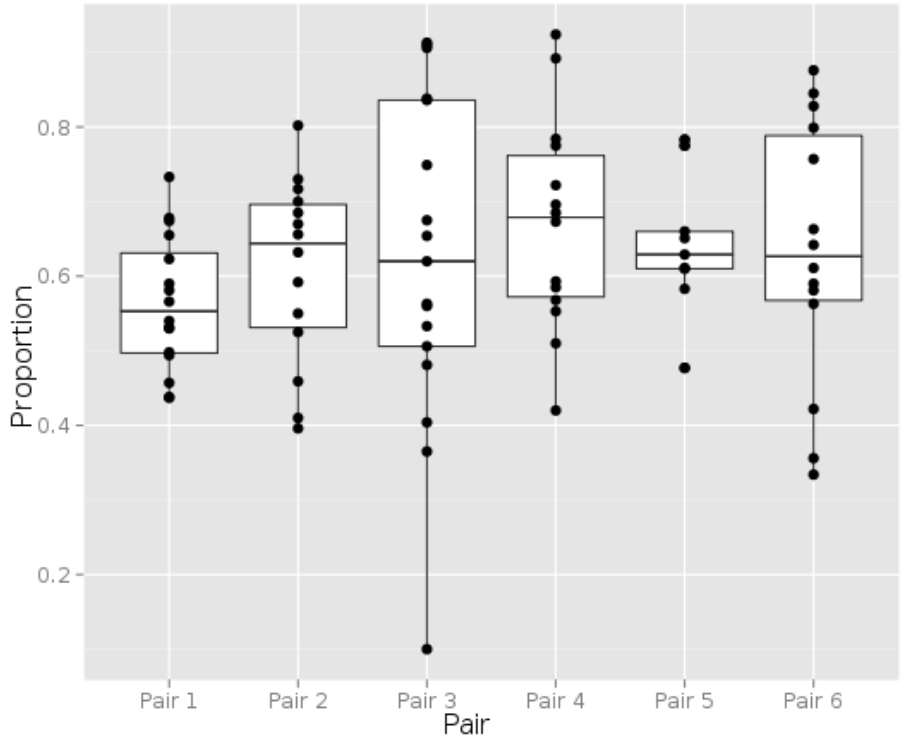
One way ANOVA worked example.
**Pre-existing Preferences of Fish** Case Study 6.2 in Sleuth




Summary Statistics:

| | Pair 1 | Pair 2 | Pair 3 | Pair 4 | Pair 5 | Pair 6 | Overall |
|---|---|---|---|---|---|---|---|
| Average | 0.564 | 0.609 | 0.624 | 0.670 | 0.642 | 0.633 | 0.621 |
| SD | 0.090 | 0.125 | 0.223 | 0.143 | 0.094 | 0.177 | 0.154 |
| Sample Size | 16 | 14 | 17 | 14 | 9 | 14 | 84 |

We are going to perform a one-way analysis of variance to answer the question:
**Does the pair of males make a difference in the preference of the females for the males with yellow swordtails?**

1. Read the study description in Sleuth 6.1.2. Are causal inferences possible? Are population inferences possible?

2. Fill in the blanks:

The null hypothesis is that all groups have the _____ _____.
The alternative hypothesis is that _____ one group has a different _____.

3. Fill in the blanks with a number:

In the reduced model we have to estimate _____ mean/s.
In the full model we have to estimate _____ mean/s.

4. What is the **full model residual** for the female fish that spends 0.54 proportion of the time with the yellow sword male in Pair 1?

5. What is the **reduced model residual** for the female fish that spends 0.54 proportion of the time with the yellow sword male in Pair 1?

6. Calculate the pooled standard deviation, and it's degrees of freedom.

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2 + \ldots (n_I-1)s_I^2}{(n_1-1) + (n_2-1) + \ldots (n_I-1)}}$$

6. Find the within group sum of squares and the total sum of squares using the shortcuts from homework 6.

Within group sum of squares = $s_p^2$ x (degrees of freedom for $s_p$)
=

Total sum of squares = (Overall SD)$^2$ x (n - 1)
=

8. Fill in the ANOVA table.

| | Sum of squares | d.f | Mean Square | F-statistic | p-value |
|---|---|---|---|---|---|
| Between Groups | | | | | |
| Within Groups | | | | | |
| **Total** | | | | | |

If the null hypothesis is true, the F-statistic will be distributed like a __-distribution with ___ and ___ degrees of freedom.

The p-value can be found in R with: `1 - pf( ________, _____, _____)`

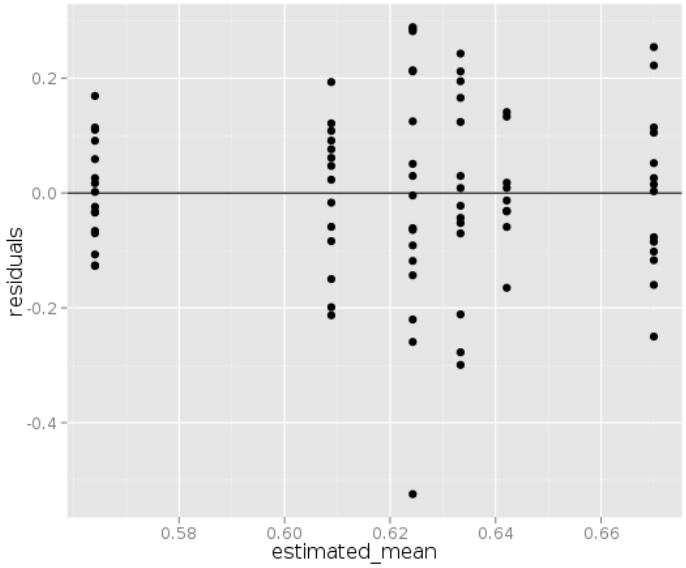
9. **Statistical summary**. Fill in the blanks:

There is _____ evidence that the mean proportion of time spent with yellow sword male in different pairs are _____ (F-test, p-value = _____).

10. What are the three assumptions of the one-way ANOVA?

1.
2.
3.

Which can you check by examining the plot below?



11. Imagine we want to compare the male fish of Pair 1 to those of Pair 5.
    a. The estimated difference in mean proportion of time spent with yellow sword male in Pair 1 and Pair 5 is:

    b. The standard error on the difference estimated in a. is:

$$\mathrm{SE}_{\overline{Y}_2-\overline{Y}_1} = s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}$$

    c. A 95% confidence interval for the difference in a. is:

(Hint: qt(0.975, 78) = 1.99)