

8. **Toxicology.** A laboratory experiment compared the relative potencies of four cardiac substances. In the experiment, a suitable dilution of each substance was slowly infused into an anesthetized guinea pig, and the dosage at which the pig died was recorded. Ten guinea pigs were used for each substance for a total of 40 guinea pigs. The main research goal was to determine whether any differences existed among the potencies of the four substances, and, if so, to quantify those differences. The researchers used the ANOVA model $y_{ij} = \mu_i + \varepsilon_{ij}$, $i = 1, 2, 3, 4$, $j = 1, \dots, 10$ to address this research question.

What is H_0 for testing whether any differences exist among the potencies of the four substances?

Descriptive statistics are below.

Substance	Parameter	N	\bar{y}_i	s_i^2
1	μ_1	10	25.9	9.4
2	μ_2	10	22.2	12.2
3	μ_3	10	20.0	8.7
4	μ_4	10	19.6	8.7

The F statistic corresponding to the overall F test is 8.545 ($p < 0.001$). Does the p-value provide evidence of any difference between the groups, or not?

In order to investigate differences between species, the investigators tested differences between each pair of substances and have provided the following table.

Parameter	Estimate	95% CI
$\mu_1 - \mu_2$	3.7	(-0.2, 7.6)
$\mu_1 - \mu_3$	5.9	(2.0, 9.8)
$\mu_1 - \mu_4$	6.3	(2.4, 10.2)
$\mu_2 - \mu_3$	2.2	(-1.7, 6.1)
$\mu_2 - \mu_4$	2.6	(-1.3, 6.5)
$\mu_3 - \mu_4$	0.4	(-3.5, 4.3)

Using this table, describe differences in potencies using language suitable for journal publication.

