Quiz 4: Pomegranate Fertilizer Treatments ANOVA

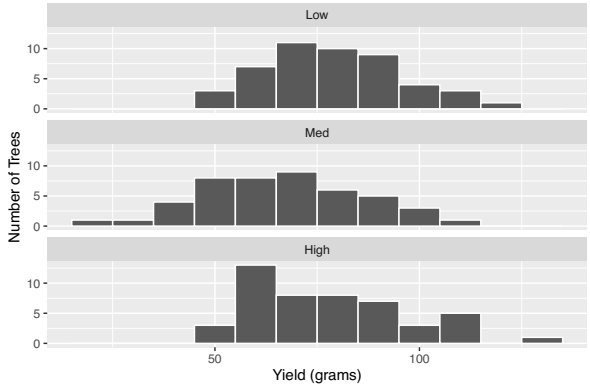
Name: Key

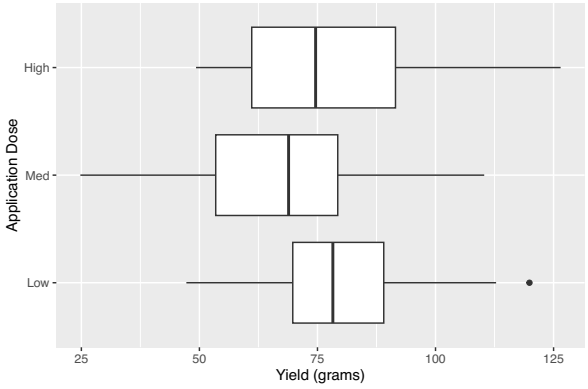
2023-12-01

In a fertilizer study for pomegranates, an AEPS grad student randomly sampled 142 trees in orchard. Then she randomly divided the trees into three fertilizer groups (low, medium, and high). During the course of the study she hand applied fertilizer at the selected levels to each of the 142 trees to keep the impact of the fertilizer local to the individual study trees.

Research Question: Does the amount of fertilizer affect the amount of fruit produced by pomegranate trees

	application_dose	min	Q1	median	Q3	max	mean	sd	n	missing
1	Low	47.24	69.77	78.26	89.04	119.89	79.47	16.34	48	0
2	Med	24.79	53.45	68.89	79.29	110.31	66.81	19.64	46	0
3	High	49.28	61.08	74.61	91.52	126.49	77.19	19.13	48	0





1. Identify the variables of interest and their data type: (2 pts)

- Explanatory Variable: Application Dose — (categorical) / numerical
- Response Variable: Yield — categorical / (numerical)

2. Set up the null and alternative hypotheses, **in symbols.** (3 pts)

$H_0: \mu_{Low} = \mu_{Med} = \mu_{High}$

H_A: At least one μ_i differs

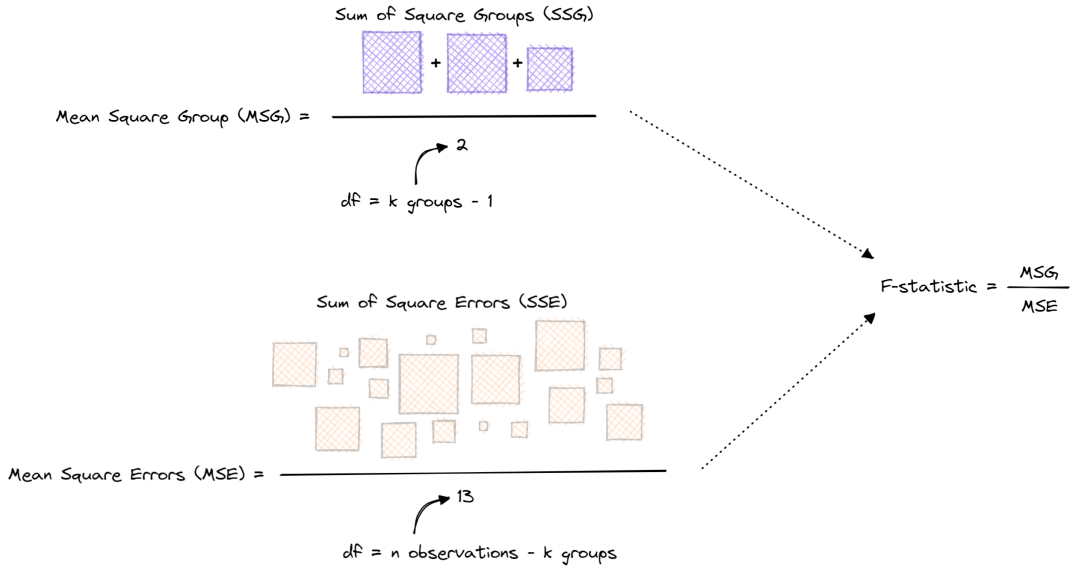
The following conducts an ANOVA to determine the impact of fertilizer amount on the pomegranate fruit yield. *Note, I have removed some values and indicated them with letters.*

```
# A tibble: 2 x 6
  term             df     sumsq meansq   statistic  p.value
  <chr>            <chr>  <dbl> <chr>    <chr>        <dbl>
1 application_dose A 2    4248. C 2124   D 6.26     0.00247
2 Residuals        B 142 47097. 338.8246 <NA>      NA
```

3. Using information from the output above, calculate the following: (6 pts)

- (C) MSG: $SSG/df_1 = 4248/2 = 2124$ (↑ 3 groups − 1)
- (D) F-statistic: $MSG/MSE = 2124/338.82 = 6.26$

Useful Information



4. If the application dose has an effect on yield, the MSG will be large relative to the MSE. Circle one. (1 pts)

(TRUE) FALSE

5. At an $\alpha = 0.05$, state your conclusion in context of the research problem. Make sure to cite appropriate values from the ANOVA table to support your statement. (3 pts)

We have strong evidence to conclude at least one application dose has a different population mean fertilizer yield ($F = 6.26$; $df1 = 2$; $df2 = 142$; $p = 0.002$).

6. What type of error could you have made? Explain in context. (2 pts)

(Type I) Type II

7. Using the output below, at an $\alpha = 0.05$, indicate which (if any) application doses have different mean pomegranate yields without any multiplicity adjustments. Support your answer with values from the output. (3 pts)

```
 contrast   estimate   SE  df lower.CL upper.CL t.ratio p.value
 Low - Med     12.65 3.80 139     5.14    20.16  3.332  0.0011
 Low - High     2.28 3.76 139    -5.15     9.70  0.606  0.5458
 Med - High   -10.38 3.80 139   -17.89    -2.87 -2.732  0.0071

Confidence level used: 0.95
```

We have evidence to conclude the population mean yield differs between application doses Low & Medium ($t = 3.32$, $df = 139$, $p = 0.0011$) and Med & High ($t = -2.723$; $df = 139$; $p = 0.0071$).

8. Complete the following sentence by circling one of the provided choices. (2 pts)

The p-values would (INCREASE / DECREASE) if we used a multiplicity adjustment such as Tukey, making it (HARDER / EASIER) to find evidence to support the research question.

_____ / 22 pts