# STAT 3202: Practice 08

*Spring 2019, OSU*

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## Exercise 1

A study compared 15 students who intended to major in engineering with 15 students who intended to major in language and literature. Given in the accompanying table are the means and standard deviations of the scores on the verbal and mathematics portion of the SAT for the two groups of students:

| | Verbal | Math |
|---|---|---|
| Engineering | $\bar{y} = 446$, $s = 42$ | $\bar{y} = 548$, $s = 57$ |
| Language/literature | $\bar{y} = 534$, $s = 45$ | $\bar{y} = 517$, $s = 52$ |

Do three things:

- Perform the ANOVA overall $F$-test to determine whether there is sufficient evidence to claim a difference in the mean math SAT scores between high school students who intend to major in engineering and and those who intend to major in language/literature. Report the $p$-value of this test. (You should find the $p$-value using `R`.)
- Perform a two-sample $t$-test to determine whether there is sufficient evidence to claim a difference in the mean verbal SAT scores for high school students who intend to major in engineering and language/literature. Again, report the $p$-value of this test. (You should find the $p$-value using `R`.)
- Compare the $p$-values of the two tests.

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## Exercise 2

In a comparison of the strengths of concrete produced by four experimental mixes, three specimens were prepared from each type of mix. Each of the 12 specimens was subjected to increasingly compressive loads until breakdown. The accompanying table gives the compressive loads, in tons per square inch, attained at breakdown.

| Mix A | Mix B | Mix C | Mix D |
|---|---|---|---|
| 2.30 | 2.20 | 2.15 | 2.25 |
| 2.20 | 2.10 | 2.15 | 2.15 |
| 2.25 | 2.20 | 2.20 | 2.25 |

Do the data provide evidence at the $\alpha = 0.05$ level that at least one of the concretes differs in average strength from the others? You may use `R` to complete this exercise. Your answer should include:

- The null and alternative hypotheses you are testing.
- A completed ANOVA table – i.e., a table formatted like the one below, with values in all starred entries:

| Source | df | SS | MS | $F$-test statistic | $p$-value |
|---|---|---|---|---|---|
| Treatment | ** | ** | ** | ** | ** |
| Error | ** | ** | ** | | |
| Total | ** | ** | | | |

- A one sentence conclusion in words.

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## Exercise 3

Water samples were taken at four different locations in a river to determine whether the quantity of dissolved oxygen, a measure of water pollution, differed from one location to another. Locations 1 and 2 were selected above an industrial plant, one near the shore and the other in midstream; location 3 was adjacent to the industrial water discharge for the plant; and location 4 was slightly downriver in midstream. Five water specimens were randomly selected at each location, but one specimen, from location 4, was lost in the laboratory. The sample sizes, means, and variances are shown in the accompanying table (the greater the pollution, the lower will be the dissolved oxygen readings). Do the data provide sufficient evidence to indicate a difference in mean dissolved oxygen content for the four locations? Provide a completed ANOVA table, including $p$-value, for this situation.

| Location | Sample Size | Sample Mean | Sample Variance |
|---|---|---|---|
| 1 | 5 | 6.08 | 0.022 |
| 2 | 5 | 6.44 | 0.013 |
| 3 | 5 | 4.78 | 0.097 |
| 4 | 4 | 6.025 | 0.029 |

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## Example 4

Returning to the data in Exercise 3, suppose researchers want to know whether the locations just above the industrial plant are less polluted than the location downriver. That is, they want to test whether the dissolved oxygen at locations 1 and 2 is higher than at location 4. Write down the appropriate hypotheses to test. Find the appropriate test statistic. What are your results at $\alpha = 0.05$?

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## Exercise 5

Three skin cleansing agents were used on nine people. For each person, a patch of skin were exposed to a contaminant and afterward cleansed by using one of the three cleansing agents, assigned at random. After 8 hours, the residual contaminant was measured, with the following results:

- SST = 1.18
- SSE = 3.02

Each cleansing agent was used three times. Test the hypothesis that there are no differences among the treatment means, using $\alpha = 0.05$.

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