

Short Problem Set 3

For each of the following three problems

- explain, in one or two sentences, which significance test you will use
- state your null hypothesis, H_0 and your alternative hypothesis, H_A
- identify the degrees of freedom, ν
- report the test statistic's critical value
- calculate the test statistic's experimental value
- interpret the result of your statistical analysis

You may use R or a calculator to calculate means and standard deviations, but complete the remainder of the analysis by hand.

1. To evaluate a new employee, the manager of an environmental lab asks her to analyze a standard sample known to contain 0.520 ppb phenol. The analyst completes three analyses, obtaining an experimental mean of 0.513 ppb and a standard deviation of 0.0500 ppb. At an α of 0.05, is there any evidence of a systematic error in her work?
2. The concentration of nitrate, NO_3^- , in public drinking water supplies is not allowed to exceed 50.0 ppm (as higher concentrations are linked to a condition called "blue baby syndrome" that affects newly-born infants). An analysis of four replicate samples drawn from a municipal water department gives the following results: 51.0 ppm, 51.3 ppm, 51.6 ppm, and 50.9 ppm. At an α of 0.05, is there any reason to suspect that the concentration of nitrate **exceeds** the legal limit? *Hmm... why is that word in a **bold font**?*
3. The titanium content of steel is determined in two analytical labs by means of atomic absorption spectrometry. The first lab analyzes eight samples, obtaining results (in %w/w Ti) of 0.470, 0.448, 0.463, 0.449, 0.482, 0.454, 0.477, and 0.409. A second lab analyzes six samples, obtaining results of 0.529, 0.490, 0.489, 0.521, 0.486, and 0.502. At an α of 0.05, is there any evidence of a systematic difference between the results obtained by these two labs?