

Name: \_\_\_\_\_  
MAT 222  
Spring 2019  
Chapter 7: *t*-tests

*“What, so everyone’s supposed to sleep every single night now. You realize that nighttime makes up half of all time?”*  
–Rick, Rick and Morty

**Problem 1:** Exposure to dust at work can lead to lung disease later in life. One study measured the workplace exposure of tunnel construction workers. Part of the study compared 115 drill and blast workers with 220 outdoor concrete workers. Total dust exposure was measured in milligrams years per cubic meter ( $\text{mg y/m}^3$ ). The mean exposure for the drill and blast workers was  $18.0 \text{ mg y/m}^3$  with a standard deviation of  $7.8 \text{ mg y/m}^3$ . For the outdoor concrete workers, the corresponding values were  $6.5 \text{ mg y/m}^3$  and  $3.4 \text{ mg y/m}^3$ .

- (a) Use a 95% confidence interval to describe the difference in the exposures.
- (b) Test the null hypothesis that the exposures for these two types of workers are the same. Justify your choice of a one-sided or two-sided alternative. Report the test statistic, the degrees of freedom, and the *p*-value. Give a short summary of your conclusion.

**Problem 2:** The Carbon Monoxide (CO) levels in a processing plant are closely monitored for worker safety. The CO levels are to remain below 40 ppm (parts per million) on average. Safety inspectors examine the factory taking bi-weekly samples for 32 weeks. They find an average CO level of 43 ppm with a standard deviation of 7 ppm.

- (a) Find a 96% confidence interval for the average ppm CO levels in the processing plant.
- (b) Test the hypothesis  $H_0 : \mu = 40$  versus  $H_a : \mu > 40$ . State your test statistics, *p*-value, and conclusion.

**Problem 3:** Sport-utility vehicles (SUVs) and pickup trucks have replaced cars in many American driveways. SUVs and trucks are often larger and heavier than cars so are under attack for reasons of safety and fuel economy. Do SUVs and trucks have lower gas milage than cars? A study of 31 midsize cars, 31 SUVs, and 14 pickup trucks was taken, using only 2-wheel drive cars, SUVs, and pickup trucks (4-wheel drive versions have poorer gas milage). The data is summarized below.

	<i>n</i>	$\bar{x}$	<i>s</i>
Midsize Cars	31	27.90	2.56
SUVs	31	22.68	3.67
Pickup Trucks	14	21.29	2.76

- (a) What is the null and alternative hypotheses for the assertion that midsize cars have greater mean gas milage than that of pickup trucks?
- (b) Construct a 99% confidence interval for the null hypothesis mean given in (a).
- (c) Use the strongest possible test to examine the assertion in (a). Give your test statistic, *p*-value, and state your conclusions.

**Problem 4:** Scientific researchers are trying to determine if a new insect repellent is effective. Since the project is in early development, they run a small experiment on 12 people, each chosen randomly. Each subject has their right arm coated in the repellent and the other left bare. They then place each arm into a box with mosquitoes for 5 minutes and the total number of bites on each arm are counted. The data is summarized below.

Subject	Right Bites	Left Bites	Subject	Right Bites	Left Bites
1	5	4	7	3	3
2	4	6	8	0	4
3	1	6	9	2	1
4	7	3	10	2	3
5	1	2	11	8	7
6	3	3	12	3	4

- What statistical method should be used in this experiment? Justify your response.
- For this statistical method, construct a 90% confidence interval and state your conclusion.
- For this statistical method, state an appropriate null and alternative hypothesis. Test these hypotheses and give your test statistic,  $p$ -value, and conclusions.