

**Name:**

**Email:**

**Practice Test 3 – Microengineering 110**

**Spring 2024**

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**For the questions on this test, you can use jupyter when appropriate, or can also use the online calculators at:**

<https://www.socscistatistics.com/tests/>

- 1) To perform a hypothesis test to see if a treatment has any effect using the z test, which of the following assumptions and information are required (you will get points for the correct answers, and lose partial points for incorrect selections)
  - Normal distribution of the original (i.e., untreated) population
  - Binomial distribution of the original (i.e., untreated) population
  - Random sampling of the treated sample to be tested
  - Sample standard deviation from the untreated population
  - Population standard deviation from the untreated population
  - Sample mean of the treated sample
  - Population mean of the treated sample
  - Sample standard deviation of the treated sample
  - Population standard deviation of the treated sample
- 2) Which of the following reasons would be good reasons to avoid the t test and use a randomization test instead (you will get points for the correct answers, and lose partial points for incorrect selections)
  - We do not have the population standard deviation of the untreated population
  - We cannot ensure truly random sampling
  - We cannot assume normality of the untreated population
  - We have access to a computer and can thus easily calculate the random untreated dataset
- 3) Suppose I am designing an airplane, and am I am doing a t test to ensure survivability of the plane after a proposed engine upgrade. Would a 95% confidence interval be a good standard for the t test?
  - Yes
  - No

- 4) Your mobile phones are made with a scratch-resistant glass. This is achieved by using specific heat treatments to control the stresses in the glass and the hardness of the glass. Suppose you are evaluating the following heat treatments:
- Heat at 500°C in Argon
  - Heat at 500°C in Oxygen
  - Heat at 600°C in Argon
  - Heat at 600°C in Oxygen

Which of the following tests would be the appropriate statistical analysis method for this experiment, and why?

- A series of z tests, since we have lots of population data about glass
  - A series of t tests, since we only have access to sample data
  - ANOVA, since we have multiple categorical treatments
  - ANOVA, since we have multiple continuous treatments
- 5) Suppose I have access to lots of past data from an untreated population, and also have access to the sample mean and sample standard deviation from a sample of the untreated population. Which of the following statements are true? (you will get points for the correct answers, and lose partial points for incorrect selections)
- The empirical test will be better than a t test if we cannot assume normality
  - The empirical test is always better than a t test since it is based on actual data
  - The empirical test may be worse than a t test if the past data is not representative of the population
  - If we ensure random sampling, a t test should always be better than an empirical test
  - We can compare the empirical test results to a t test to test for normality of the population
- 6) A manufacturer of Lithium batteries knows that the average lifetime for a particular model of batteries is 150 cycles. The manufacturer develops a new battery. Samples of this new battery were taken, and were found to have the following cycle life (copy from moodle)

Number of samples	Average cycle life	Sample standard deviation
30	170	40

Perform a t test to determine if the new battery is actually better (HINT: since the original battery data is from a population rather than a sample, you will use the one sample t-test, which is

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

What is the calculated t value?

2.738

7) What is the p value?

0.009

8) Should we use a 1-sided or 2-sided test, since we don't know if the change will improve things or make things worse?

- 1 sided
- 2 sided

9) The values of x and their corresponding values of y are:

	Point1	Point2	Point3	Point4	Point5
X	0	1	2	3	4
Y	2	3	5	4	6

Determine the value of the correlation coefficient r

0.9

10) Determine the value of the slope of the least squares regression line

0.9

11) A fertilizer factory is trying to reduce the amount of ammonia they use per container of fertilizer. They try out two different modifications to the original process. The ammonia consumed per container is below for several samples from each of the processes.

Original	Modification A	Modification B
1200	1000	890
1000	1100	650
980	700	1100
900	800	900
750	500	400
800	700	350

What is the overall average?

817.8

12) What is the value of  $S_T$ ?

152477

13) What is the value of  $S_R$ ?

819833

14) What is the value of  $F$ ?

1.395

s

15) What is the p value?

0.278

16) Why did we use ANOVA here rather than using a series of t-tests

- There is no 3 treatment t test
- Since there is no pairing, t tests are not appropriate
- Errors tend to accumulate when using multiple t tests

17) If the ANOVA test above indicated that the null hypothesis was FALSE, which of the following statements would be true:

- Both modifications have an effect
- Modification A has an effect
- Modification B has an effect
- At least one of the modifications has an effect