

# MAT121 Statistics I

## Midterm Exam 3

Thursday, 11/17/2022

*There are 25 Questions in this midterm. Please mark your answers on the scan sheet provided and Check for your first and last name on your answer sheet.*

1. A statistic on the basis of which a decision is made about the hypothesis of interest is called

- A). Test statistics
- B). Significance level
- C). Statement of hypothesis
- D). Critical region

**Answer: A**

2. Type-I error will occur if

- A). a diseased person is diagnosed as disease-free.
- B). a disease-free person is diagnosed as diseased
- C). the doctor ordered a wrong lab
- D). None of these

**Answer: A**

3. In a t-test of population mean, the number of degrees of freedom is

- A).  $n$
- B).  $n-1$
- C). 1
- D). 30

**Answer: B.**

4. The region of rejection of  $H_0$  is called

- A). rejection region
- B). Test statistics
- C). Type-I error
- D). Acceptance region

**Answer: A**

5. A \_\_\_\_\_ error is made if  $H_a$  is true but  $H_0$  is accepted

- A). Type-I
- B). Type-II
- C). Sampling error
- D). The standard error of the mean

**Answer: B.** This is equivalent to a person has no disease ( $H_a$  is true) but is diagnosed as diseased person ( $H_0$  is wrong).

6. The region of acceptance of  $H_0$  is called

- A). Critical region
- B). Test statistics
- C). Type-I error
- D). Acceptance region

**Answer D.**

7. The choice of one-tailed test and two-tailed test depends upon

- A). Null hypothesis
- B). Alternative hypothesis
- C). Composite hypothesis
- D). None of these

**Answer B.**

8. Which one is an example of two-tailed test

- A).  $H_a: \mu \neq 0$
- B).  $H_a: \mu > 0$
- C).  $H_a: \mu \geq 0$
- D).  $H_a: \mu = 0$

**Answer: A.**

9. If  $\alpha = 0.05$ , the value of one-tailed normal test statistic will be

- A). 1.96
- B). 1.64
- C). 2.33
- D). 2.58

**Answer: B.**

10. When critical region is located on both side of the curve, it is called

- A). One tail test
- B). Two-tailed test
- C). Left tailed test
- D). Right tailed test

**Answer: B.**

11. A drink vending machine is adjusted so that, on average, it dispenses 220 mls of fruit juice (with a standard deviation of 10mls) into a plastic cup. However, the machine has a tendency to go out of adjustment and periodic checks are made to determine the average amount of fruit juice actually being dispensed. A sample of 45 drinks is taken to test the adjustment of the machine. For  $\alpha=5\%$ , an appropriate decision rule would be

- A). reject the null if the test statistic is greater than 1.96
- B). do not reject the null if the test statistic is less than 1.96
- C). reject the null if the test statistic is not equal to 1.96
- D). reject the null if the test statistic is either less than or greater than 1.96

**Answer: D.** “the machine has a tendency to go out of adjustment and periodic checks are made to determine the average amount of fruit juice actually being dispensed.” Implies that this is a two-tailed test.

12. An analyst is conducting a hypothesis test to determine if the mean time spent on investment research is different from 3 hours per day. The test is performed at the 1% level of significance and uses a random sample of 64 portfolio managers, where the mean time spent on research is found to be 2.5 hours. The population standard deviation is 1.5 hours. What is the value of the test statistic in this case?

- A).  $TS = -2.67$
- B).  $TS = 1.645$
- C).  $TS = 2.575$
- D).  $TS = -1.96$

**Answer: A.**  $TS = (2.5-3)/(1.5/\sqrt{64}) = -2.67$

13. According to a certain TV broadcast station, the average number of violent incidents shown per episode of a TV series is 7. A researcher believes that this has increased in the last few years. A random sample of 16 recent episodes is selected which produced a sample mean of 6.9 violent incidents and standard deviation 1.2. Assume that the number of violent incidents follows a normal distribution. If we were to perform a hypothesis test at level of 0.05 in order to test whether the researcher’s belief is accurate or not, what would be the critical value?

- A).  $CV = 2.131$
- B).  $CV = 1.746$
- C).  $CV = 1.645$
- D).  $CV = 1.753$

**Answer: A.** The claim is  $\mu = 7$ . The alternative is “not equal to”. This is a two-tailed t-test with 15 degrees of freedom.  $CV = 2.131$

14. A hypothesis test is conducted to test whether the mean age of clients at a certain health spa is equal to 25 or not. 36 clients are randomly selected, and their ages recorded, with the sample mean age being 27.8 and standard deviation 10. Assume that the population distribution of ages is skewed to the right. What is the p-value?

- A). p-value = 1.68
- B). p-value = .9535
- C). p-value = 0.0465
- D). p-value = 0.093

**Answer: D.**  $TS = (27.8-25)/(10/\sqrt{36}) = 1.68$ . Since this is a two-tailed test, the p-value is 2 times the smaller tail area (0.0465). The p-value =  $2 \times 0.0465 = 0.093$ .

15. A hypothesis test is to be conducted to test whether a certain population mean is equal to or greater than 24.4. A sample of size 64 is selected from the population and the sample mean is calculated as being 26.52 and standard deviation 7.6. What is the value of the test statistic for this test?

- A).  $TS = 1.14$
- B).  $TS = 0.12$
- C).  $TS = 2.23$
- D).  $TS = -0.90$

**Answer: C.** Just use the formula of the test statistic for testing population mean:  $(26.52-24.4)/(7.6/\sqrt{64}) = 2.2315$ .

16. In a random sample of 400 electrical components, 84 are found to be defective. If the hypothesis is that 20 % of the components are defective, what is the value of the test statistic that would test this claim (choose the one that is closest to yours)?

- A).  $TS = 0.5$
- B).  $TS = 1.960$
- C).  $TS = 0.05$
- D).  $TS = 0.025$

**Answer: A.**  $TS = (0.21-0.20)/\sqrt{0.2*(1-0.2)/400} = 0.5$  OR  $TS = (0.21-0.20)/\sqrt{0.21*(1-0.21)/400} = 0.491$ .

17. Dentists believe that 53 % of the general population suffers from tooth decay. The makers of Toothy Grin Toothpaste believe that using their product reduces tooth decay, and in order to support their claim study a random sample of 2000 Toothy Grin users. 56% of these are suffering from tooth decay. The evidence is investigated to see whether these figures present enough evidence to indicate a *decrease*

in tooth decay for the Toothy Grin users. What is the appropriate test statistic value for this test? (Hint: Choose the one that is closest to yours)

- A). TS = 2.70
- B). TS = 1.96
- C). TS = 1.64
- D). TS = 2.57

**Answer: A.**  $TS = (0.56-0.53)/\sqrt{(0.56*(1-0.56)/2000)} = 2.70$

18. A social scientist claims that the average adult watches *less than* 26 hours of television per week. He collects data on 36 individuals' television viewing habits and finds that their mean number of hours watching television was 22.4 hours and standard deviation 8 hours. Assume the significance level adopted is 1% . What is the statistical decision based on the sample?

- A). Since p-value = 0.0035 < 0.01, we reject the null hypothesis and conclude that the social scientist is right
- B). Since p-value = 0.0035 < 0.01, we fail to reject the alternate hypothesis and conclude that the social scientist is right
- C). Since p-value = 0.05 > 0.007, we fail to reject the null hypothesis and conclude that the social scientist's claim cannot be proved
- D). Since p-value = 0.005 < 0.007, we fail to reject the null hypothesis and conclude that the social scientist's claim cannot be proved.

**Answer: A.** This is a left tailed test. The test statistic  $TS = (22.4-26)/(8/\sqrt{36}) = -2.7$ , the p-value = left-tail are = 0.0035 < 0.01.  $H_0$  is rejected.

19. In a hypothesis test, the following random sample of six observations was selected from a normal distribution {98, 105, 108, 115, 105, 111} that yields a mean of 107 and standard deviation 5.8. You are asked to conclude whether the population mean is different from 100. What is the value of the test statistic in this case (rounded to 2 decimal places)?

- A). 7.24
- B). 2.96
- C). 5.80
- D). 1.96

**Answer: B.**  $TS = (107-100)/(5.8/\sqrt{6}) = 2.956$ .

20. The mean life of a battery used in a digital clock is 305 days. The lives of the batteries follow a normal distribution. The battery was recently modified to last longer. A sample of 20 of the modified batteries had a mean life of 307 days with a standard deviation of 12 days. A hypothesis test is undertaken to determine whether the modification *increased* the battery life. The null and alternative hypotheses are

- A).  $H_0: \mu \leq 305$  vs  $H_a: \mu > 305$
- B).  $H_0: \mu = 305$  vs  $H_a: \mu \neq 305$

- C).  $H_0: \mu < 305$  vs  $H_a: \mu \geq 305$   
D).  $H_0: \mu > 305$  vs  $H_a: \mu \leq 305$

**Answer: A.** "increased the battery life" implied right tailed-test.

21. Two samples of sizes 25 and 35 are independently drawn from two normal populations, where the unknown variances are assumed to be equal. The number of degrees of freedom for the equal-variances t-test statistic is:

- A). 58  
B). 60  
C). 62  
D). 57

**Answer: A.** Degrees of freedom =  $25 + 35 - 2 = 58$ .

22. When the necessary conditions are met, a two-tail test is conducted to test the difference between two population means. The statistical software in use only provides one tail p-values as part of its output. Given a one-tail p-value of 0.036, what would a two-tail p-value for the same test be?

- A). 0.018  
B). 0.009  
C). 0.072  
D). 0.964

**Answer: A.** The two-tailed p-value = 2 times the smaller tail area =  $2 \times 0.036 = 0.072$ .

23. Two independent samples from populations that are normally distributed produced the following statistics: for sample 1 the sample size was 11, the sample mean was 34.2 and the sample standard deviation was 12.6. For sample 2, the sample size was 13, the sample mean was 49.1 and the sample standard deviation was 19.4. Assume that population variances are equal. Given a significance level of 5%, at what approximate the t-critical value should you reject the null hypothesis that states that the two population means are equal, in favor of the two sided alternative?

- A).  $CV = \pm 1.987$   
B).  $CV = \pm 1.990$   
C).  $CV = \pm 1.994$   
D).  $CV = \pm 2.074$

**Answer: D.** The degrees of freedom is  $11 + 13 - 2 = 22$ . The significance level is 0.05. Since this is a two-tailed test. The right-tail area = 0.025. The critical value  $CV = \pm 2.074$ .