

MAT121 Statistics I

Midterm Exam 3

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.

Suppose you wish to test the claim that μ_d , the mean value of the differences d for a population of paired data, is greater than 0. Given a sample of $n = 15$, a significance level of $\alpha = 0.01$, and differences are normally distributed, what criterion would be used for rejecting the null hypothesis?

- A). Reject null hypothesis if test statistic > 2.602 .
- B). Reject the null hypothesis if the test statistic > 2.977 or < -2.977 .
- C). Reject null hypothesis if test statistic > 2.624 .
- D). Reject the null hypothesis if the test statistic < 2.624 .

Answer C.

3. The average growth of a certain variety of pine trees is 10.1 inches in three years. A biologist claims that a new variety will have greater three-year growth. A random sample of 25 of the new variety has an average three-year growth of 10.8 inches and a standard deviation of 2.1 inches. With the convention of the null hypothesis, the appropriate null and alternative hypotheses to test the biologist's claim are:

- A. $H_0: \mu=10.8$ against $H_a: \mu>10.8$
- B. $H_0: \mu=10.8$ against $H_a: \mu \neq 10.8$
- C. $H_0: \mu=10.1$ against $H_a: \mu>10.1$
- D. $H_0: \mu=10.1$ against $H_a: \mu<10.1$

Answer: C.

4. The following are percentages of fat found in 5 samples of each of two brands of baby food:

- I: 5.7, 4.5, 6.2, 6.3, 7.3
- II: 6.3, 5.7, 5.9, 6.4, 5.1

Which of the following procedures is appropriate to test the hypothesis of equal average fat content in the two types of ice cream?

- A. Paired t-test with 5 d.f
- B. Two samples t-test with 8 d.f
- C. Paired t-test with 4 d.f
- D. Two samples t-test with 9 d.f

Answer B.

5. Suppose we wish to test $H_0: \mu \geq 21$ vs $H_a: \mu < 21$. Which of the following sample results gives the most evidence to support H_a (i.e., reject H_0)? [Hint: compute $TS = ?$]

- A. $\bar{x} = 23, s = 3, n = 36$.
- B. $\bar{x} = 20, s = 6, n = 36$.
- C. $\bar{x} = 19, s = 7, n = 36$.
- D. $\bar{x} = 18, s = 8, n = 36$.

Answer D.

6. A bottling company needs to produce bottles that will hold 12 ounces of liquid. Periodically, the company gets complaints that their bottles are not holding enough liquid. To test this claim, the bottling company randomly took 36 bottles. Suppose the p-value of this test turned out to be 0.0455. State the proper conclusion.

- A. At $\alpha = 0.085$, fail to reject the null hypothesis.
- B. At $\alpha = 0.035$, accept the null hypothesis.
- C. At $\alpha = 0.05$, reject the null hypothesis.
- D. At $\alpha = 0.025$, reject the null hypothesis.

Answer C.

7. The area to the left of the test statistic is 0.375. What is P- the value if this is a right tail test?

- A. 0.625
- B. 0.1885

C. 0.750

D. 0.375

Answer: A.

8. Test Statistic: $t = 2.374$, Critical Values: $t = \pm 2.011$. There is _____ evidence to _____ the claim that the before and after results are the same (i.e., the difference of before and after means are equal!).

A. not enough / reject

B. enough / support

C. enough / reject

D. not enough / support

Answer: C

9. 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 C.

10. The owner of Bun & Run Hamburgers wishes to compare the sales per day at two different locations. The mean number of hamburgers sold for 10 randomly selected days at Northside was 83.55 with a population standard deviation of 10.50. For a randomly selected 12 days at Southside, the mean number of hamburgers sold was 69.54 with a population standard deviation of 14.25. We

wish to test whether there is a difference in the mean number of hamburgers sold at the two locations using a 5% significance level. Assume that distributions of the sales at two locations are normally distributed and with equal variances. What is the value of the test statistic in this case?

- A. 1.84
- B. 0.24
- C. 2.50
- D. 1.71

Answer C.

11. Two independent samples from populations that are normally distributed produced the following statistics: for sample 1 the sample size was 50, the sample mean was 34.2 and the sample standard deviation was 12.6. For sample 2, the sample size was 32, the sample mean was 49.1 and the sample standard deviation was 19.4. Given a significance level of 5%, Is there evidence to **reject** the null hypothesis that states that the means of the two populations are equal? [Hint: draw a density curve to help find the RR.]

- A. Yes, since $TS = 3.86$ is in the rejection region $RR = (-\infty, -1.96) \cup (1.96, \infty)$
- B. Yes, since $TS = 1.96$ is in the rejection region $RR = (-\infty, -1.645) \cup (1.645, \infty)$
- C. Yes, since $TS = 3.86$ is in the rejection region $RR = (-\infty, -1.645) \cup (1.645, \infty)$
- D. Yes, since $TS = 1.645$ is in the rejection region $RR = (-\infty, -1.96) \cup (1.96, \infty)$

Answer: A.

12. Joe Palermo interviewed 507 randomly chosen WCU students and found that 59% of the students in his sample like to play chess. Consider the research question of whether or not a majority of WCU students like to play chess. The test for this research question is a:

- A. Neither a one-sided nor two-sided test.
- B. One-sided test.
- C. Both a one-sided and two-sided test.

D. Two-sided test.

Answer: B.

13. In a survey, 1,865 out of 2,246 randomly selected adults in the United States said that texting while driving should be illegal. Using these results, conduct a hypothesis test at the 5% significance level to test the claim that more than 80% of adults believe that texting while driving should be illegal. What is the P-value?

A. < 0.999

B. < 0.001

C. > 3.55

D. $= 1.96$

Answer B.

14. The health of the bear population in Yellowstone National Park is monitored by periodic measurements taken from anesthetized bears. In a sample of 100 bears, the mean weight was found to be 185 lbs. Assume that σ (population standard deviation) is known to be 125 lbs., use a 0.03 significance level to test the claim that the population mean weight of bears is equal to 210 lbs. What is the value of the test statistic?

A. 2.00

B. 0.0228

C. -2.00

D. 0.0456

Answer C.

15. A recent study showed that 53% of college applications were submitted online. Assume that this result is based on a simple random sample of 1,000 college applications, with 530 submitted online. Use a 0.01 significance level to test the claim that among all college applications, the percentage submitted online is equal to 50%.

Identify the null and alternative hypotheses:

- A. $H_0: p \geq .50$ vs $H_1: p < .50$
- B. $H_0: p = .50$ vs $H_1: p \neq .50$
- C. $H_0: p > .50$ vs $H_1: p \leq .50$
- D. $H_0: p \leq .50$ vs $H_1: p > .50$

Answer B.

16. Two types of flares are tested and their burning times (in minutes) are recorded. The summary statistics are given below.

Brand X	Brand Y
$n_1 = 35$	$n_2 = 40$
$\bar{x}_1 = 19.4$	$\bar{x}_2 = 15.1$
$s = 1.4$	$s = 0.8$

Use a 0.05 significance level to test the claim that the two samples are from populations with the **same** mean. State your conclusion along with the test statistic.

- A. Fail to reject the null hypothesis; $t = -16.025$.
- B. Reject the null hypothesis; $t = 16.025$
- C. Reject the null hypothesis; $t = -16.025$
- D. Fail to reject the null hypothesis; $t = 16.025$

Answer: B.

17. The region of rejection of H_0 is called

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

Answer: A

18. 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 A.

19. Which one is an example of a 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.

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

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

Answer D.

21. 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.

22. 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 was selected which produced a sample mean of 6.9 violent incidents and a standard deviation of 1.2. Assume that the number of violent incidents follows a normal distribution. If we were to perform a hypothesis test at the 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 D.

23. 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 were randomly selected, and their ages were recorded, with the sample mean age being 27.8 and a standard deviation of 10. Assume that the population distribution of ages is skewed to the right. What is the p-value?

A). $p\text{-value} = 1.68$

B). $p\text{-value} = .9535$

C). $p\text{-value} = 0.0465$

D). $p\text{-value} = 0.093$

Answer D.

24. 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.

25. 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.

Problem 26.

Mr. S has an appetite for a certain brand of potato chips, which are typically packaged in 14 oz. bags. However, Mr. S has come to suspect that the net weight of the chips in each bag is significantly less than the advertised 14 ounces, leading him to want to test the hypotheses

$$H_0 : \mu = 14, H_a : \mu < 14.$$

He sends Erica out to perform some measurements, who returns with the sample mean of $\bar{x} = 13.82$ oz. and the sample deviation of $s_x = 0.24$ oz. for 16 bags of these chips. Based on Erica's measurements, and assuming that the weights are approximately normally distributed, we would

- a) reject H_0 at significance level 0.10 but not at 0.05.
- b) reject H_0 at significance level 0.05 but not at 0.025.
- c) reject H_0 at significance level 0.025 but not at 0.01.
- d) reject H_0 at significance level 0.01.**

Problem 27

A patient claims that he consumes only 2000 calories per day, but a dietician suspects that the actual figure is higher. The dietician plans to check his food intake for 30 days and will reject the patient's claim if the 30-day mean is more than 2100 calories. Assuming that the patient's true standard deviation is $\sigma=350$ calories per day, what is the p-value?

- A) 0.03
- B) 0.06
- C) 0.12
- D) 0.28

Answer C

Problem 28

A company is interested in knowing the effects of a computer training program. The company randomly selected 25 employees and measured their computer skills before and after the training program. To test the hypothesis, $H_0: \mu_1 = \mu_2$, the test statistic is a:

- A z-statistic
- B t-statistic with 49 degrees of freedom.
- C t-statistic with 24 degrees of freedom

D chi-square statistic with 23 degrees of freedom

Answer C

Problem 29

The NCHS reported that the mean total cholesterol level in 2002 for all adults was 203. Total cholesterol levels in participants who attended the seventh examination of the Offspring in the Framingham Heart Study are summarized as follows: $n=1200$, $\bar{x}=200.3$, and $s=36.8$. What is the test statistic?

- A 1.96
- B -2.54
- C 2.21
- D -1.96

Problem 30

The owner of a local nightclub has recently surveyed a random sample of $n = 300$ customers of the club. She would now like to determine whether or not the mean age of her customers is over 35. If so, she plans to alter the entertainment to appeal to an older crowd. If not, no entertainment changes will be made. Suppose she found that the sample mean was 35.5 years and the population standard deviation was 5 years. What is the p-value associated with the test statistic?

- a. 0.9582
- b. 1.7300
- c. 0.0418
- d. 0.0836

Answer C

Problem 31

A survey was conducted to get an estimate of the proportion of smokers among the graduate students. The report says 38% of them are smokers. Chatterjee doubts the result and thinks that the actual proportion is much less than this. Choose the correct choice of null and alternative hypothesis Chatterjee wants to test.

- a) $H_0: p > .38$ versus $H_a: p \leq .38$.
- b) $H_0: p \leq .38$ versus $H_a: p > .38$.
- c) $H_0: p \geq .38$ versus $H_a: p < .38$.
- d) $H_0: p \leq .38$ versus $H_a: p < .38$.

Answer: C

Problem 32

A pharmaceutical company **claims that 8% or fewer** of the patients taking their new statin drug will have a heart attack in 5 years. In a government-sponsored study of 2300 patients taking the new drug, 198 have heart attacks in 5 years. Is this strong evidence against the company's claim?

- A. Yes, because the P-value is 0.005657.
- B. Yes, because the P-value is 0.086087.
- C. No, because the P-value is only 0.005657.
- D. No, because the P-value is only 0.086087.
- E. No, because the P-value is over 0.10.

Answer: D. Left-tailed test with p-value = 0.152. Fail to reject H0 (the company's claim)

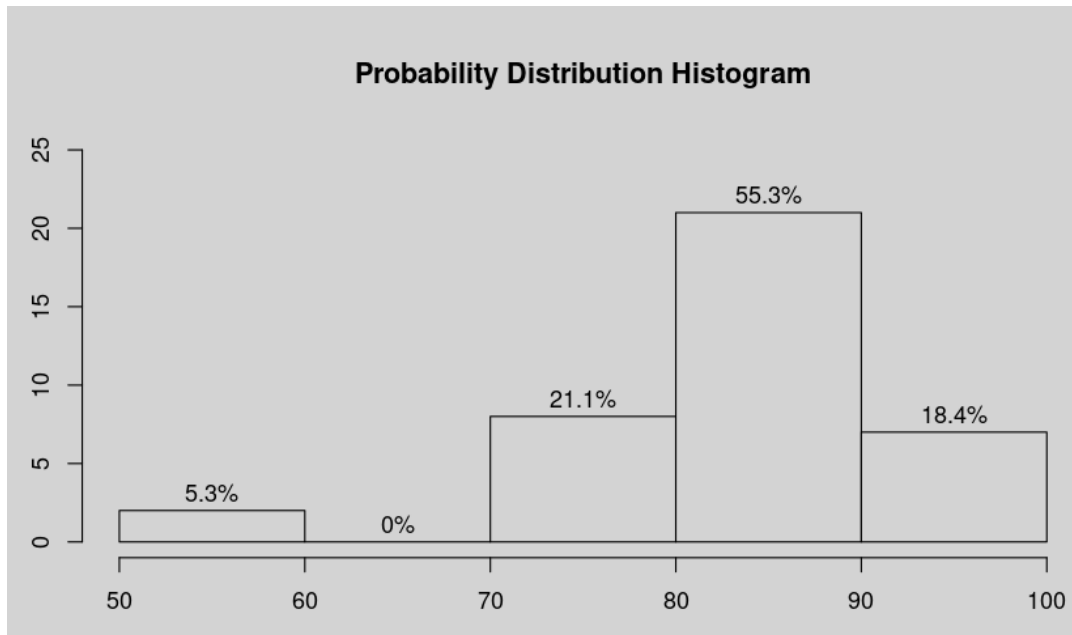
Problem 33

A research dermatologist believes that cancers of the head and neck will occur **most often** on the left side (*that is, the proportion is greater than 50%*), the side next to a window when a person is driving. In a review of 565 cases of head/neck cancers, 305 occurred on the left side. That is, the sample proportion is $305/565 = 0.54$. What is the resulting P-value?

- A. $P \left[Z > \frac{0.54 - 0.50}{\sqrt{0.46 \times 0.54 / 565}} \right]$
- B. $P \left[Z > \frac{0.54 - 0.50}{\sqrt{0.46 \times 0.54 / 305}} \right]$
- C. $P \left[Z < \frac{0.54 - 0.50}{\sqrt{0.46 \times 0.54 / 565}} \right]$
- D. $P \left[Z < \frac{0.54 - 0.50}{\sqrt{0.46 \times 0.54 / 305}} \right]$

Answer A.

Summary of Midterm Exam



1. Five Number Summary :

The five-number summary is used to describe the shape of the distribution of a given numerical data. It consists of five numbers: minimum data value, first quartile, median, the third quartile, and the maximum data value.

The five-number summary of this given data set is:

stats	value
Min.	55.00
1st Qu.	79.50
Median	85.00
3rd Qu.	88.00
Max.	94.00

2. Boxplot :

The boxplot is a geometric representation of the five-number summary. The boxplot of the given data set is given below.

