Supplementary HW problems for Test 1

Multiple Choice problems

1. The owner of travel agency would like to determine whether or not the **mean age** of the agency's customers is **over 24.** If so, he plans to alter the destination of their special cruises and tours. If he concludes the mean age is over 24 when it is not, he makes a _______ error. If he concludes the mean age is not over 24 when it is, he makes a ______error.

   A) Type II; Type II   B) Type I; Type I   C) Type I; Type II   D) Type II; Type I

2. **Suppose we wish to test** $H_0: \mu \le 53$ vs $H_a: \mu > 53$ **. What will result if we conclude that the mean is greater than 53 when its true value is really 55**?

   A) We have made a Type I error   B) We have made a correct decision
   C) We have made a Type II error   D) None of the above are correct

3. **The value that separates a rejection region from an acceptance region is called a ___________.**

   A) parameter   B) critical value   C) confidence coefficient   D) significance level

4. A hypothesis test is used to prevent a machine from underfilling or overfilling quart bottles of beer. On the basis of sample, the machine is shut down for inspection. A thorough examination reveals there is nothing wrong with the filling machine. From a statistical point of view:

   A) Both Type I and Type II errors were made.   B) A Type I error was made.
   C) A Type II error was made.   D) A correct decision was made.

5. **Suppose we wish to test** $H_0: \mu \ge 21$ vs $H_a: \mu < 21$**. Which of the following possible sample results gives the most evidence to support** H_a **(i.e., reject** H_0 **)?** Hint: Compute Z-score

   A) $\bar{x} = 23,\ s = 3$ B) $\bar{x} = 19,\ s = 4$ **C)** $\bar{x} = 17,\ s = 7$ D) $\bar{x} = 18,\ s = 6$

6. **Given H_0: μ = 25, H_a: $\mu \neq$ 25, and P-value = 0.041. Do you reject or fail to reject H_0 at the 0.01 level of significance**?

   A) fail to reject H_0 B) not sufficient information to decide   C) reject H_0

7. 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 samples 36 bottles. Suppose the **p–value** of this test turned out to be **0.0455**. State the proper conclusion.

   A) At α = 0.085, fail to reject the null hypothesis.   B) At α = 0.035, accept the null hypothesis.
   C) At α = 0.05, reject the null hypothesis.   D) At α = 0.025, reject the null hypothesis.

8. **If a hypothesis test were conducted using α = 0.05, for which of the following p–values would the null hypothesis be rejected?**

   A) 0.100   B) 0.041   C) 0.055   D) 0.060

9 . For **Ha**: **$\mu > \mu_o$** p-value is 0.042. What will be p-value for **Ha**: **$\mu < \mu_o$**?

A) 0.084 B) 0.021 C) 0.958 D) 0.042

10. The test statistic is t = 2.63 and the p-value is 0.9849. What type of test is this?

A) Right tail B) Two tail C) Left tail D) Can't tell

11. The test statistic is z =2.75, the critical value is z = 2.326 The P- value is ...

A) Less than the significance level B) Equal to the significance level C) Large than the significance level

12. The area to the left of the test statistic is 0.375. What is the probability value if this is a left tail test?

A) 0.750 B) 0.375 C) 0.1885 D) 0.625

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

A) 0.625 B) 0.1885 C) 0.750 D) 0.375

14. Test Statistic: t = 2.374, Critical Values: t = +/- 2.011. There is ________ evidence to ________ the claim that the before and after results are the same.

A) not enough / reject B) enough / support C) enough / reject D) not enough / support

15. Cattle with mad cow's disease are butchered and sent to grocery stores. What type of error is this?

A) Not enough info B) Correct decision C) Type I **D) Type II**

The assumed condition is that cow's are not infected with mad cow's disease. Since these cattle have the disease, the null hypoth false and the error is to retain the null hypothesis. This is a type II error.

16. A 90% confidence interval for the population mean is 18 < mu < 24. What is the sample mean?

A) 21 B) 6 C) 10% D) 3

17. There is a fire, but the smoke detector doesn't go off. What type of error is this?

A) Type II Error B) There is no error C) Type I Error

18. P-value = 0.001, Significance Level = 0.05. There is __ evidence to _____the claim that more women than men speed.

A) enough / support B) not enough / support C) not enough / reject D) enough / reject

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

A) 0.625 B) 0.750 C) 0.375 D) 0.1885

20. If you are testing the claim: $\mu > 96$, and your significance level is 8%, what is the probability that you commit the type one error?

a) At least 8% b) At most 8% c) Equal 8% d) less than 8 %

21. For Ha: $\mu \neq \mu_o$ P-value is 0.2. The sign of Test Statistic is negative. What is P-value for Ha: $\mu > \mu_o$?

A) 0.2 B) 0.1 C) 0.4 D) 0.9 E) 0.8

22. Explain what the phrase "95% confident" means when we interpret a 95% CI for μ.

A) 95% of the observations in the population fall within the bounds of the calculated interval.

B) In repeated sampling, 95% of constructed intervals would contain the value of μ.

C) The probability that the mean falls in the calculated interval is 0.95.

D) 95% of similarly constructed intervals would contain the value of the sampled mean.

23. What will result in a reduced interval width of the confidence interval for μ ?

A) Increase the confidence level and increase the sample size

B) Decrease the sample size and decrease the confidence level

C) Increase the sample size and decrease the confidence level.

D) Decrease the sample size and increase the confidence level.

24. An consultant came up with a new plan to increase productivity at your office. When you compared those who followed the plan to those in a different office who did not adopt the plan, your p-value was .85. Is this plan helpful?

a) Probably

b) It would depend on how the other office does when it adopts the plan

c) Not likely

d) Even knowing how the other office would do if the plan were adopted, there is not enough information to answer the question

25. In a recent study, it was reported that snake oil salespeople are rated more likely to lie to their customers than politicians to their constituents. The p-value from the study is 0.5. Is the report accurate and, if not, which report would be the most accurate?

a) Not enough information to tell

b) Politicians are the bigger liars

c) Politicians and snake oil sales people are rated equally as liars

d) The existing report is accurate

26. A confidence interval was used to estimate the proportion of flights that were delayed. A random sample of 95 flights generated the following 95% confidence interval: (.04, .08). Based on the interval above, is the population proportion of delayed flights equal to 5%?

A) Yes, and we are 95% sure of it. B) Maybe. C) No, the proportion is 6%. D) No, and we are 95% sure of it.

27. A 95% confidence interval for a population mean is (28, 35).

Can you reject the null hypothesis that μ=36 at 5 % significance level? Why?

Yes, Ho: μ=36 could be rejected at 5 % significance level since CI doesn't include μ=36 as a plausible parameter value.

Answers:

Problem	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	C	B	B	B	C	A	C	B	C	C	A	B	A	C	D
Problem	16	17	18	19	20	21	22	23	24	25	26				
Answer	A	A	A	B	B	D	B	C	C	C	B				

Open format problems

1.Suppose we would like to determine if the typical amount spent per customer for dinner is more than $20.00. A sample of 49 customers was randomly selected and the average amount spent was $22.60. Assume that the SD is known to be $2.50. Using a 0.02 level of significance, would we conclude the typical amount spent per customer is more than $20.00?

2.Suppose an editor of a publishing company claims that the mean time to write a textbook is less than 15 months. A sample of 16 textbook is randomly selected and it is found that the mean time was 12.5 and SD was 3.6 months. Assuming the time to write a textbook is normally distributed and using a 0.025 level of significance, would you conclude the editor's claim is true?

3.Suppose, the average U. S. household spends $90 per day. You recently took a random sample of 30 households in Huntsville and the results revealed a mean of $84.50. Suppose the SD is known to be $14.50. Using a 0.05 level of significance, can it be concluded that the average amount spent per day by U.S. households has decreased?

4. Suppose the mean salary for full professors in the United States is believed to be $71,650. A sample of 16 full professors revealed a mean salary of $73,800 and SD of $5,000, can it be concluded that the average salary has increased using a 0.05 level of significance?

5. Historically, evening long-distance calls have averaged 15.2 minutes per call. In a random sample of 25 calls, the mean time was 14.3 minutes and SD was 5 minutes. Using a 0.05 level of significance, is there sufficient evidence to conclude that the average long-distance call has decreased?

6. A production line operates with a mean filling weight of 16 ounces per container. A quality control inspector samples 30 items to determine whether or not the filling weight has to be adjusted. The sample revealed a mean of 16.32 ounces and SD was equal to .8 ounces. Using α = 0.10 can it be concluded that the process is out of control (not equal to 16 ounces)?

7. A 94 % CI for the mean amount of coffee dispensed by vending machine is: (7.2, 7.6) oz.

a) Interpret this confidence interval in context of the problem.

b) What is the value of the point estimator that was used to construct this interval?

c) Calculate the sampling error to within the average length of time was estimated.

d) Suppose you want to reduce the width of the confidence interval to half of its current size. Calculate the approximate sample size to achieve the desired accuracy of the estimate. It is known that observations ranged in value between 6.8 ounce and 8.6 ounce. Assume that the range of the data is equal to 4 σ.

8. A 96% confidence interval for the proportion of registered voters across the U.S.A. who would prefer a " Super morally straight person" to be the president of United States is: (56%, 60%).

a) Find a point estimate for the true proportion, p, that prefer a president to be a morally straight person.

b) What is the sampling error of estimation?

c) How many registered voters are required in the sample to reduce in half the bound within which we need to estimate the true proportion of voters who prefer a "Super morally straight person" to be the president of United States?

9. A 95% CI for the true percentage of students getting their PhDs is (2.0%, 4.0%). Random sample of 300 graduates was taken for estimation. Was the sample size a sufficient?

10. Fat Harry's, a popular student hangout, sells 16-ounce glasses of beer. Ten students purchase a total of 22 glasses and, using their own measuring cup, estimate the mean contents. The sample mean is 15.2 oz with s = 0.86 oz. At the 95% level of confidence, are the students getting their money's worth?

11. Increasing numbers of businesses are offering child-care benefits for their workers. However, one union claims that more than 80% of firms still do not offer any child-care benefits. A random sample of 500 companies is selected, and only 80 of them offer child-care benefits. Test the union claim at α = 0.05.

12. A coin is tossed 1000 times and 540 heads appear. At α = 0.03, test the claim that this is a biased coin.

Solutions

1. **H_o: $\mu = 20$**

H_a: $\mu > 20$

T.S. $Z = \dfrac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \dfrac{22.60 - 20}{\frac{2.50}{\sqrt{49}}} = 7.28$ **RR: Reject H_o if $Z > 2.05$**

P-value = P(Z > 7.28) = 0.000 P-val < α =➔ Decision: Reject Ho

Conclusion: At α = 0.02 there is sufficient evidence to conclude the typical amount spent per customer is more than $20.00.

2. **H_o: $\mu = 15$**

H_a: $\mu < 15$ d.f. = 15, $t_{.025} = -2.131$

T.S. $t = \frac{\bar{x}-\mu}{\frac{S}{\sqrt{n}}} = \frac{12.5-15}{\frac{3.6}{\sqrt{16}}} =$ **-2.78** **RR: Reject Ho if t < -2.131**

Decision: Reject Ho

0.005 < P-value < 0.01 ===➔ P-value < α ➔ Reject Ho

Conclusion: At α = 0.025 there is sufficient evidence to conclude the editor's claim is true.

3. **Ho: μ = 90**

Ha: μ < 90

T.S. $Z = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{84.50-90}{\frac{14.50}{\sqrt{30}}} =$ **-2.08** **RR: Reject Ho if Z < -1.645**

P-value = P(Z < -2.08) = 0.0188 P-val < α Reject Ho

Decision: Reject Ho

Conclusion: At α = 0.05 there is sufficient evidence to conclude the average amount spent per day by U.S. households has decreased.

4. **Ho: μ = 71,650**

Ha: μ > 71,650

T.S. $t = \frac{\bar{x}-\mu}{\frac{S}{\sqrt{n}}} = \frac{73{,}800-71{,}650}{\frac{5{,}000}{\sqrt{16}}} =$ **1.72** **D.f. = 15** **RR: Reject Ho if t > 1.753**

0.05 < P-value < 0.10 ===➔ P-value > α ➔ fail to Reject Ho

Decision: Fail to Reject Ho

Conclusion: At α = 0.05 there is insufficient evidence to conclude the average salary has increased.

5. **Ho: μ = 15.2**

Ha: μ < 15.2 **d.f. = 24,** $t_{.05}$ **= -1.711**

T.S. $t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}} = \frac{14.3 - 15.2}{\frac{5}{\sqrt{25}}} = $ **-0.9** **RR: Reject Ho if t < -1.711**

P-value > 0.10 ===➔ P-value > α ➔ Decision: Fail to Reject Ho

Conclusion: At α = 0.05 there is insufficient evidence to conclude the average evening long-distance call has decreased.

6. **Ho: μ = 16**

Ha: μ ≠ 16

T.S. $Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{16.32 - 16}{\frac{0.8}{\sqrt{30}}} = $ **2.19** **RR: Reject Ho if Z < - 1.645 or Z > 1.645**

P-value = 2(P > 2.19) = 0.0286 P-val < α ==➔ Decision: Reject Ho

Conclusion: At α = 0.10 there is sufficient evidence to conclude the process is out of control.

7. a) ***We are 94% confident that average amount of coffee dispensed by this machine is within 7.2 and 7.6 oz.***

b) $\bar{x} = 7.4$ oz

c) **SE = 0.2 oz**

d) Range = 8.6 – 6.6 = 2.0 oz, R = 4 σ = 2.0 oz ➔ σ = 0.5 oz; new SE = .2 /2 = 0.1oz

$$n = \left(\frac{Z_{\alpha/2} \cdot \sigma}{SE}\right)^2 = \left(\frac{1.88 \cdot 0.5}{0.1}\right)^2 = 88.36$$ **Answer: n = 89 (Round up!)**

8. a) $\hat{p}$ **= 58%**

b) SE = 2%

c) $$n = \frac{\left(z_{\alpha/2}\right)^2 \hat{p}\hat{q}}{(SE)^2} = \frac{(2.05)^2 .58 \cdot .42}{(0.01)^2} = 148.45$$ **Answer: n = 149**

9. Not sufficient. $\hat{p}$ **= 3% np = 300 x 0.03 = 9 < 15**

10. **μ_o = 16 oz (Hypothesized Parameter value)**

$\bar{x} = 15.2$ oz (Point – estimator)

$$\overline{X} \pm Z_{\alpha/2}\frac{S}{\sqrt{n}} = \mathbf{15.2} \pm 2.08\frac{0.86}{\sqrt{22}} = \mathbf{15.2 \pm 0.4}$$

Answer: (14.8, 15.6) oz. Possible Interpretation: You are 95% confident that these students are not getting the 16 oz of beer (too much foam), since the 16 oz does not fall within the interval. There needs to be a boycott of this pub or at least an organized picket. Demand your rights to a full mug!

11. Hypothesized Parameter value: $p_o = .80$ Number of Successes X = 500 – 80 = 420

H_o: P = .80

H_a: P > .80

Point –estimator: $\hat{p} = \frac{x}{n} = \frac{420}{500} = .84$ **T.S.:** $Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} = \frac{.84 - .80}{\sqrt{\frac{.8 \times .2}{500}}} = \mathbf{2.24}$

RR: Reject H_o if Z > 1.645

P-value = P(Z > 2.24) = 0.5 – 0.4875 = 0.0125 P-val < α ➔ Decision: Reject Ho

Conclusion: At α = 0.05 there is sufficient evidence to conclude that more than 80% of firms still do not offer any child-care benefits.

12. Hypothesized Parameter value: $p_o = .50$ Number of Successes X = 540

H_o: P = .50

H_a: P ≠ .50

Point –estimator: $\hat{p} = \frac{x}{n} = \frac{540}{1000} = .54$ **T.S.:** $Z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} = \frac{.54 - .50}{\sqrt{\frac{.5 \times .5}{1000}}} = \mathbf{2.53}$

RR: Reject H_o if Z > 2.17 or Z < -2.17

P-value = 2 × P(Z > 2.53) = 2(0.5 – 0.4943) = 0.0114 P-val < α ➔ Decision: Reject Ho

Conclusion: At α = 0.03 there is sufficient evidence to conclude that coin is biased.