

## MATH 3307

### Homework 12 (Lessons 33 - 35)

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**Instructions:** Answer all questions through the EMCF tab of casa under the assignment named "Homework 12" before the deadline.

There is no "Submit" button. Your answers will be automatically submitted once the deadline arrives.

Assignments will be graded out of 20 points.

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For Questions 1 - 3, refer to the following: Nitrites are often added to meat products as preservatives. In a study of the effect of these chemicals on bacteria, the rate of uptake of a radio-labeled amino acid was measured for a number of cultures of bacteria, some growing in a medium to which nitrites have been added. Here are the summary statistics from this study:

Group	$n$	$\bar{x}$	$s$
Nitrite	30	7880	1115
Control	30	8112	1250

Carry out a test of the research hypothesis that nitrites decrease amino acid uptake at the 2% significance level.

1. Determine the Null and Alternate Hypothesis and the Rejection Region:

- [Group 1: Nitrite;  
Group 2: Control]
- A.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 < \mu_2$ ; Rejection Region:  $z < -2.05$
  - B.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 < \mu_2$ ; Rejection Region:  $t < -2.15$
  - C.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 > \mu_2$ ; Rejection Region:  $t > 2.15$
  - D.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 \neq \mu_2$ ; Rejection Region:  $z < -2.33$  or  $z > 2.33$
  - E.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 \neq \mu_2$ ; Rejection Region:  $t < -2.46$  or  $t > 2.46$

2. Determine the Test Statistic:

- A.  $t = -26.130$
- B.  $z = -0.759$
- C.  $t = -0.746$
- D.  $z = -26.130$
- E.  $t = -0.759$

3. Determine the p-value and conclusion:

- A.  $p = 0.454$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- B.  $p = 0.227$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- C.  $p = 0.227$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- D.  $p = 0.454$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- E.  $p = 0.448$ ;  $FRH_0$  (No sufficient evidence to reject the claim)

For Questions 4 - 6, refer to the following: Two methods were used to teach a high school algebra course. A sample of 75 scores was selected for method 1, and a sample of 60 scores was selected for method 2. The results are:

	Method 1	Method 2
Sample mean	85	83
Sample s.d.	3	2

Test whether method 1 was more successful than method 2 at the 1% level.

4. Determine the Null and Alternate Hypothesis and the Rejection Region:

[Group 1: Method 1; Group 2: Method 2]

- A.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 < \mu_2$ ; Rejection Region:  $z < -2.33$
- B.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 < \mu_2$ ; Rejection Region:  $t < -2.39$
- C.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 > \mu_2$ ; Rejection Region:  $t > 2.39$
- D.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 > \mu_2$ ; Rejection Region:  $z < -2.33$
- E.  $H_0: \mu_1 = \mu_2$ ;  $H_a: \mu_1 \neq \mu_2$ ; Rejection Region:  $t < -2.66$  or  $t > 2.66$

5. Calculate the Test Statistic:

- A.  $t = 7.385$
- B.  $z = 4.629$
- C.  $t = 4.629$
- D.  $z = 7.385$
- E.  $t = 4.595$

6. Determine the p-value and conclusion:

- A.  $p = 0.00001$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- B.  $p = 0.648$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- C.  $p = 0.677$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- D.  $p = 0.454$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- E.  $p = 0.648$ ;  $FRH_0$  (No sufficient evidence to reject the claim)

For Questions 7 - 9, refer to the following: A private and a public university are located in the same city. For the private university, 1046 alumni were surveyed and 653 said that they attended at least one class reunion. For the public university, 791 out of 1327 sampled alumni claim that they attended at least one reunion. Is the difference in the sample proportions significantly different at the 1% significance level?

7. Determine the Null and Alternate Hypothesis and the Rejection Region:

[Group 1: Private University; Group 2: Public University]

- A.  $H_0: p_1 = p_2$ ;  $H_a: p_1 < p_2$ ; Rejection Region:  $z < -2.33$
- B.  $H_0: p_1 = p_2$ ;  $H_a: p_1 < p_2$ ; Rejection Region:  $z < -1.64$
- C.  $H_0: p_1 = p_2$ ;  $H_a: p_1 > p_2$ ; Rejection Region:  $z > 2.33$
- D.  $H_0: p_1 = p_2$ ;  $H_a: p_1 \neq p_2$ ; Rejection Region:  $z < -2.58$  or  $z > 2.58$
- E.  $H_0: p_1 = p_2$ ;  $H_a: p_1 \neq p_2$ ; Rejection Region:  $t < -3.02$  or  $t > 3.02$

8. Calculate the Test Statistic:

- A.  $z = 1.372$
- B.  $z = 1.398$
- C.  $z = 69.517$
- D.  $z = 1.400$
- E.  $z = 6.508$

9. Determine the p-value and conclusion:

- A.  $p = 0.919$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- B.  $p = 0.162$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- C.  $p = 0.919$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- D.  $p = 1.838$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- E.  $p = 0.162$ ;  $FRH_0$  (No sufficient evidence to reject the claim)

For Questions 10 - 12, refer to the following: Data taken from a random sample of 60 students chosen from the student population of a large urban high school indicated that 36 of them planned to pursue post-secondary education. An independent sample of 50 students taken at a neighboring large suburban high school resulted in data that indicated that 31 of those students planned to pursue post-secondary education. Do these data provide sufficient evidence at the 5% level to reject the hypothesis that these population proportions are equal?

10. Determine the Null and Alternate Hypothesis and the Rejection Region:

[Group 1: Urban; Group 2: Suburban]

- A.  $H_0: p_1 = p_2$ ;  $H_a: p_1 < p_2$ ; Rejection Region:  $z < -1.96$
- B.  $H_0: p_1 = p_2$ ;  $H_a: p_1 < p_2$ ; Rejection Region:  $z < -1.64$
- C.  $H_0: p_1 = p_2$ ;  $H_a: p_1 > p_2$ ; Rejection Region:  $z > 1.64$
- D.  $H_0: p_1 = p_2$ ;  $H_a: p_1 \neq p_2$ ; Rejection Region:  $z < -1.96$  or  $z > 1.96$
- E.  $H_0: p_1 = p_2$ ;  $H_a: p_1 \neq p_2$ ; Rejection Region:  $z < -1.64$  or  $z > 1.64$

11. Calculate the Test Statistic:

- A.  $z = -0.214$
- B.  $z = -2.296$
- C.  $z = -0.205$
- D.  $z = 13.071$
- E.  $z = 2.225$

12. Determine the p-value and conclusion:

- A.  $p = 0.415$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- B.  $p = 0.831$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- C.  $p = 0.585$ ;  $FRH_0$  (No sufficient evidence to reject the claim)
- D.  $p = 0.585$ ;  $RH_0$  (Sufficient evidence exists to reject the claim)
- E.  $p = 0.415$ ;  $FRH_0$  (No sufficient evidence to reject the claim)

For Questions 13 - 16, refer to the following: The community hospital is studying its distribution of patients. A random sample of 317 patients presently in the hospital gave the following information. Using a 5% level of significance, test the claim that the distribution of patients in these wards has not changed.

Type of patient	Old rate of occurrences of these types of patients	Present number of occurrences of these types of patients
Maternity ward	20%	65
Cardiac ward	32%	100
Burn ward	10%	29
Children's ward	15%	48
All other wards	23%	75

13. Determine the null and alternate hypotheses.
- Ho: exp = obs; Ha: exp < obs
  - Ho: exp = obs; Ha: exp > obs
  - Ho: exp = obs; Ha: exp ≠ obs
  - Ho: exp = obs; Ha: exp = obs
  - There is no null or alternate hypotheses for this scenario
14. Determine the value of the Test Statistic:
- $\chi^2 = 0.036$
  - $\chi^2 = 0.355$
  - $\chi^2 = 315.36$
  - $\chi^2 = 1101.94$
  - $\chi^2 = 0.6322$
15. Section 8.5; Problem 2 (p-value, conclusion)
- p = 0.9965
  - p = 0.9985
  - p = 0.0065
  - p = 0.9860
  - p = 0.0035
16. Draw a conclusion:
- RHo: Expected values are equal to Observed
  - FRHo: Expected values are not equal to Observed
  - RHo: Expected values are not equal to Observed
  - FRHo: Expected values are equal to Observed
  - No Conclusion

17. Previous studies on sleep tendencies report that, on average, an adult American will sleep for 6 hours each night with a standard deviation of 0.75 hours. You survey a SRS of 100 adult Americans and determine that the mean sleep time is 5 hours. Which Hypothesis Test should be used here?

18. Previous studies on sleep tendencies report that 65% of adult Americans do not get the recommended amount of nightly sleep. You survey a SRS of 100 adult Americans and determine that 78% do not get the recommended amount of nightly sleep. Which Hypothesis Test should be used here?

19. A previous study on sleep tendencies report that 15% of adult Americans are significantly sleep deprived, 35% are sleep deprived, 25% sleep an appropriate amount, 15% oversleep a slight amount, and 10% significantly oversleep. To confirm these results, you survey a SRS of 100 adult Americans to and find that 28 are significantly sleep deprived, 42 are sleep deprived, 21 get an appropriate amount of sleep, 7 oversleep, and 2 sleep excessively too much. Which Hypothesis Test should be used here?

Answer Choices for Questions 17, 18, and 19:

- A. One-sample t-test for means
- B. One-sample z-test for means
- C. One sample z-test for proportions
- D. One sample t-test for proportions
- E. Chi-squared goodness of fit test

20. A certain retail store bases its staffing on the number of customers that arrive during certain time slots. Based on prior experience this store expects 32% of its customers between 8:00 am and 12:00 pm; 21% of its customers between 12:00 pm and 4:00 pm; 35% of its customers between 4:00 pm and 8:00 pm; and 12% of its customers between 8:00 pm and midnight. On a certain day, the store had 214, 198, 276, and 134 customers in those time slots, respectively. Should the store change its staffing? (Consider an alpha of 0.05.)

*Proposed Solution:*

$H_0$ : The expected values match the observed values

$H_a$ : The expected values do not match the observed values

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assign("exp",c(32,21,35,12))
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assign("obs",c(214,198,276,134))
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sum((obs-exp)^2/exp) = 5426.773
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1-pchisq(5426.773,3) = 0
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$p < \alpha$ , therefore  $RH_0$ : the store should change its staffing.

What was wrong with the proposed solution?

- A. In the calculation of  $\chi^2$ , observed quantities should be subtracted from expected quantities.
- B. Expected values were given as percentages and were handled in the formula as quantities.
- C. The degrees of freedom should match the number of categories, in this case, 4.
- D. This is not the correct method to test a hypothesis of this nature.
- E. There is nothing wrong with the proposed solution.