Math 2200 Exam 3

Instructions: When doing hypothesis testing, if not particularly mentioned, the significance level is 0.05.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Answer the question.

1) In a large statistics class, the professor has each student toss a fair coin 48 times and calculate the proportion of his or her tosses that were tails. The students then report their results, and the professor plots a histogram of these several proportions. Should a Normal model be used here?
   A) A Normal model should not be used because the sample size is not large enough to satisfy the success/failure condition.
   B) A Normal model should not be used because the sample size, 48, is larger than 10% of the population of all coins.
   C) A Normal model should not be used because the population distribution is not Normal.
   D) A Normal model should be used because the samples are random and independent. Also, the sample size, 48, is less than 10% of the population. Most importantly, the original population has a Normal distribution.
   E) A Normal model should be used because the 48 coin tosses can be thought of as a random sample of coin tosses and are fewer than 10% of the population of all coins. The success/failure condition is also satisfied because np = 24 > 10 and nq = 24 > 10.

2) When a truckload of oranges arrives at a packing plant, a random sample of 125 is selected and examined. The whole truckload will be rejected if more than 8% of the sample is unsatisfactory. Suppose that in fact 9% of the oranges on the truck do not meet the desired standard. What's the probability that the shipment will be accepted anyway?
   A) 0.3483 
   B) 0.7803 
   C) 0.2197 
   D) 0.6517 
   E) 0.6966

3) Statistics from a weather center indicate that a certain city receives an average of 23 inches of snow each year, with a standard deviation of 4 inches. Assume that a Normal model applies. A student lives in this city for 4 years. Let \( y \) represent the mean amount of snow for those 4 years. Describe the sampling distribution model of this sample mean.
   A) N(23, 2)
   B) N(23, 4)
   C) Binom(23, 4)
   D) There is not enough information to describe the distribution.
   E) N(23, 1)

Use the 68-95-99.7 Rule to answer the question about the mean credit card debt for the students in this sample.

4) At a large university, students have an average credit card debt of $2500, with a standard deviation of $1200. A random sample of students is selected and interviewed about their credit card debt. If we imagine all the possible random samples of 100 students at this university, 95% of the samples should have means between what two numbers?
   A) $2140.00 and $2860.00
   B) $100.00 and $2740.00
   C) $100.00 and $2620.00
   D) $300 and $4900
   E) $2260.00 and $2740.00
Provide an appropriate response.
10) In a survey of 1,000 television viewers, 40% said they watch network news programs. For a 99% confidence level, the margin of error for this estimate is 3.99%. If we only want to be 95% confident, how will the margin of error change?
   A) Since less confidence allows a wider interval, the margin of error will be larger.
   B) Since less confidence allows a narrower interval, the margin of error will be smaller.
   C) Since less confidence allows a wider interval, the margin of error will be smaller.
   D) Since less confidence allows a narrower interval, the margin of error will be larger.
   E) There is not enough information to determine the effect on the margin of error.

Write the null and alternative hypotheses you would use to test the following situation.
11) At a local university, only 62% of the original freshman class graduated in four years. Has this percentage changed?
   A) $H_0$: $p = 0.62$
     $H_A$: $p = 0.62$
   B) $H_0$: $p < 0.62$
     $H_A$: $p = 0.62$
   C) $H_0$: $p < 0.62$
     $H_A$: $p > 0.62$
   D) $H_0$: $p = 0.62$
     $H_A$: $p = 0.62$
   E) $H_0$: $p = 0.62$
     $H_A$: $p < 0.62$

Provide an appropriate response.
12) A weight loss center provided a loss for 72% of its participants. The center’s leader decides to test a new weight loss strategy on a random sample size of 140 and found weight loss in 78% of the participants. Test an appropriate hypothesis and state your conclusion. Be sure the appropriate assumptions and conditions are satisfied before you proceed.
   A) $H_0$: $p = 0.72$; $H_A$: $p = 0.72$; $z = 1.54$; P-value = 0.1236. This data does not show a weight loss in more than 72% of the participants in the weight loss strategy; the manager should continue strategies.
   B) $H_0$: $p = 0.72$; $H_A$: $p > 0.72$; $z = -1.54$; P-value = 0.0618. This data does not show a weight loss decrease in more than 72% of the participants in the weight loss strategy; the manager should change strategies.
   C) $H_0$: $p = 0.72$; $H_A$: $p < 0.72$; $z = 1.54$; P-value = 0.9382. This data shows a weight loss in more than 72% of the participants in the weight loss strategy; the manager should continue strategies.
   D) $H_0$: $p = 0.72$; $H_A$: $p < 0.72$; $z = -1.54$; P-value = 0.9382. This data shows a weight loss in more than 72% of the participants in the weight loss strategy; the manager should change strategies.
   E) $H_0$: $p = 0.72$; $H_A$: $p > 0.72$; $z = 1.58$; P-value = 0.0571. This data does not show a weight loss in more than 72% of the participants in the weight loss strategy; the manager should change strategies.
13) A state university wants to increase its retention rate of 4% for graduating students from the previous year. After implementing several new programs during the last two years, the university reevaluated its retention rate. Identify the Type I error in this context.
   A) The university stops all new programs, but in fact retention is on the rise and the programs help.
   B) The university concludes that retention is on the rise, but in fact the new programs do not help retention.
   C) The university concludes that retention is on the rise since the retention rate can only increase.
   D) The university sampled all students at the university.
   E) The product of the university’s sample size and sample proportion was less than 10.

14) A survey investigates whether the proportion of 8% for employees who commute by car to work is higher than it was five years ago. Identify the Type II error in this context.
   A) The survey concludes that commuting by car is on the rise, but in fact there is no change in commuting.
   B) The survey states there is no change in commuting, but in fact commuting by car is increasing.
   C) The product of the survey’s sample size and sample proportion was less than 10.
   D) The survey sampled only a dozen employee commuters.
   E) The survey concludes that commuting by car is on the rise since the commuting can only increase.

Construct the indicated confidence interval for the difference in proportions. Assume that the samples are independent and that they have been randomly selected.

15) In a random sample of 300 women, 68% favored stricter gun control legislation. In a random sample of 200 men, 56% favored stricter gun control legislation. Construct a 98% confidence interval for the difference in the proportions of women and men who favor stricter gun control legislation.
   A) (0.017, 0.223)
   B) (0.006, 0.234)
   C) (0.029, 0.211)
   D) (0.017, 0.234)
   E) (0.033, 0.207)

A two-sample z-test for two population proportions is to be performed using the P-value approach. The null hypothesis is $H_0 : p_1 = p_2$ and the alternative is $H_a : p_1 \neq p_2$. Use the given sample data to find the P-value for the hypothesis test. Give an interpretation of the p-value.

16) A poll reported that 3 out of 50 college seniors surveyed did not have jobs, while 7 out of 50 college juniors did not have jobs during the academic year.
   A) P-value = 0.1824; There is about a 18.24% chance that the two proportions are equal.
   B) P-value = 0.1824; If there is no difference in the proportions, there is about a 18.24% chance of seeing the observed difference or larger by natural sampling variation.
   C) P-value = 0.0613; If there is no difference in the proportions, there is about a 6.13% chance of seeing the exact observed difference by natural sampling variation.
   D) P-value = 0.0613; There is about a 6.13% chance that the two proportions are equal.
   E) P-value = 0.0072; If there is no difference in the proportions, there is about a 0.72% chance of seeing the observed difference or larger by natural sampling variation.
Interpret the confidence interval.
   17) A credit union took a random sample of 40 accounts and obtained the following 90% confidence interval for the mean checking account balance at the institution: $2183 < \mu(\text{balance}) < $3832.
      A) We are 90% confident that the mean checking account balance in the U.S. is between $2183 and $3832.
      B) We are 90% confident that the mean checking account balance at this credit union is between $2183 and $3832, based on this sample.
      C) About 9 out of 10 people have a checking account balance between $2183 and $3832.
      D) If we took random samples of checking accounts at this credit union, about nine out of ten of them would produce this confidence interval.
      E) We are 90% sure that the mean balance for checking accounts in the sample was between $2183 and $3832.

Use the t-tables, software, or a calculator to estimate the indicated P-value.
   18) P-value for t ≤ 1.76 with 24 degrees of freedom
      A) 0.0228  B) 0.0456  C) 0.9088  D) 0.9772  E) 0.9544

Construct the requested confidence interval from the supplied information.
   19) A sample of 81 statistics students at a small college had a mean mathematics ACT score of 26 with a standard deviation of 4. Find a 95% confidence interval for the mean mathematics ACT score for all statistics students at this college.
      A) (25.6, 26.1)  B) (25.6, 26.4)  C) (25.9, 26.1)  D) (26.4, 26.9)  E) (25.1, 26.9)

Provide an appropriate response.
   20) How tall is your average statistics classmate? To determine this, you measure the height of a random sample of 15 of your 100 fellow students, finding a mean height of 68 inches and a standard deviation of 2.3 inches. Have the conditions and assumptions for inference been met?
      A) Yes, all conditions and assumptions have been met.
      B) No, the sample is not representative.
      C) No, the sample wasn’t random.
      D) No, the sample is more than 10% of the population.
      E) No, the population is not likely to be Normal.

Use the given sample data to construct the indicated confidence interval for the population mean.
   21) The football coach randomly selected ten players and timed how long each player took to perform a certain drill. The times (in minutes) were:
       7.2  11.2  13.3  11.6  12.1
       13.4  14.3  11.3  7.5  6.4
      Determine a 95% confidence interval for the mean time for all players.
      A) (8.82, 12.84)
      B) (8.92, 12.84)
      C) (8.92, 12.74)
      D) (12.74, 12.84)
      E) (8.82, 12.74)
Determine the margin of error in estimating the population parameter.

22) How tall is your average statistics classmate? To determine this, you measure the height of a random sample of 15 of your 100 fellow students, finding a 95% confidence interval for the mean height of 67.25 to 69.75 inches.
   A) 1.06 inches
   B) 1.25 inches
   C) 0.25 inches
   D) 1.5 inches
   E) Not enough information is given.

Provide an appropriate response.

23) Suppose you have obtained a confidence interval for \( \mu \), but wish to obtain a greater degree of precision. Which of the following would result in a narrower confidence interval?
   I. Increasing the sample size while keeping the confidence level fixed
   II. Decreasing the sample size while keeping the confidence level fixed
   III. Increasing the confidence level while keeping the sample size fixed
   IV. Decreasing the confidence level while keeping the sample size fixed
   A) III, IV  B) I, IV  C) II, III  D) I, III  E) II, IV

Use a hypothesis test to test the given claim.

24) Marc wants to know if the mean age of the prison population in his city is less than 26 years. He obtains a random sample of 25 prisoners, and finds a mean age of 24.4 years and a standard deviation of 9.2 years. At a significance level of 0.05, what is his conclusion?
   A) There is not enough information to perform the test.
   B) Fail to reject the null hypothesis of \( \mu = 26 \) with a \( P \)-value of 0.1966. There is not sufficient evidence that the mean age is less than 26 years.
   C) Reject the null hypothesis of \( \mu = 26 \) with a \( P \)-value of 0.0425. The evidence suggests that the mean age is less than 26 years.
   D) Fail to reject the null hypothesis of \( \mu = 26 \) with a \( P \)-value of 0.8034. There is not sufficient evidence that the mean age is less than 26 years.
   E) Reject the null hypothesis of \( \mu = 26 \) with a \( P \)-value of 0.018. There is sufficient evidence that the mean age is less than 26 years.

Construct the indicated confidence interval for the difference between the two population means. Assume that the assumptions and conditions for inference have been met.

25) 77 Brand X oil filters and 101 Brand Y oil filters were tested for milligrams of residue, with the following results. Find a 95% confidence interval for \( \mu_Y - \mu_X \).

<table>
<thead>
<tr>
<th></th>
<th>Sample Mean</th>
<th>Sample Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand X</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Brand Y</td>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

A) (0.31, -0.34)
B) (-0.66, -0.34)
C) (0.34, 0.66)
D) (-1.06, 0.96)
E) (0.28, 0.72)
Indicate the correct test procedure and reasoning.

26) A researcher wishes to determine whether listening to music affects students' performance on memory test. He randomly selects 50 students and has each student perform a memory test once while listening to music and once without listening to music. He obtains the mean and standard deviation of the 50 "with music" scores and obtains the mean and standard deviation of the 50 "without music scores". Which test should be used and why?
   A) Not enough information given to determine correct type of test.
   B) Pooled t-test, since the standard deviation is likely to be the same in both populations.
   C) Two-sample t-test, since the researcher has two samples.
   D) z-test for each sample, since the researcher has the sample standard deviation.
   E) Paired t-test, since there is a "with music" and "without music" score for each person.

Use the paired t-interval procedure to obtain the required confidence interval for the mean difference. Assume that the conditions and assumptions for inference are satisfied.

27) Ten different families are tested for the number of gallons of water a day they use before and after viewing a conservation video. Construct a 90% confidence interval for the mean of the difference of the "before" minus the "after" times if d(after−before) = −.4.8 and s_d=5.2451

<table>
<thead>
<tr>
<th></th>
<th>33</th>
<th>33</th>
<th>38</th>
<th>33</th>
<th>35</th>
<th>40</th>
<th>40</th>
<th>31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>After</td>
<td>34</td>
<td>28</td>
<td>25</td>
<td>28</td>
<td>33</td>
<td>31</td>
<td>29</td>
<td>35</td>
</tr>
</tbody>
</table>

A) (1.5,6.1)  B) (2.6,7.8)  C) (3.8,5.8)  D) (2.5,7.1)  E) (2.1,7.5)

Provide an appropriate response.

28) Suspecting that a die may be unfair, you want to investigate. To check, you roll it 54 times, recording the number of times each face appears.

<table>
<thead>
<tr>
<th>Face</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

How many degrees of freedom are there?
A) 16   B) 5   C) 12   D) 6   E) 3
Perform the indicated goodness-of-fit test. State your hypotheses and conclusion.

29) A die is rolled 180 times and the following data are obtained. Is the die fair?

<table>
<thead>
<tr>
<th>Number</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>41</td>
</tr>
</tbody>
</table>

A) $H_0$: The die is not fair.
   $H_A$: The die is fair (all numbers occur with equal frequency).
   Conclusion: Reject the null hypothesis. There is sufficient evidence to claim that the numbers on the die do not occur with equal frequency.

B) $H_0$: The die is not fair.
   $H_A$: The die is fair (all numbers occur with equal frequency).
   Conclusion: Do not reject the null hypothesis. There is insufficient evidence to claim that the numbers on the die do not occur with equal frequency.

C) $H_0$: The die is fair (all numbers occur with equal frequency).
   $H_A$: The die is not fair.
   Conclusion: Do not reject the null hypothesis. The data do not provide sufficient evidence to conclude that the die is loaded.

D) $H_0$: The die is not fair.
   $H_A$: The die is fair (all numbers occur with equal frequency).
   Conclusion: Do not reject the null hypothesis. There is sufficient evidence to claim that the numbers on the die do not occur with equal frequency.

B) $H_0$: The die is fair (all numbers occur with equal frequency).
   $H_A$: The die is not fair.
   Conclusion: Reject the null hypothesis. There is sufficient evidence to claim that the numbers on the die do not occur with equal frequency.

Decide whether or not the conditions and assumptions for inference with a chi-square test are satisfied. If they are not, then state why.

30) A researcher wishes to test the effectiveness of a flu vaccination. Fifty randomly selected people are vaccinated, 80 randomly selected people are vaccinated with a placebo, and 300 randomly selected people are not vaccinated. The number in each group who later caught the flu was recorded. The results are shown below.

<table>
<thead>
<tr>
<th></th>
<th>Vaccinated</th>
<th>Placebo</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caught the flu</td>
<td>7</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Did not catch the flu</td>
<td>43</td>
<td>66</td>
<td>281</td>
</tr>
</tbody>
</table>

A) No, because the expected cell frequency condition is violated.
B) No, because the data are quantitative.
C) Yes
D) No, because the data do not appear to be random.
E) No, because the observed counts are too close to the expected counts.