Statistics 150  
Final Exam  
Form X  
Fall 2001  
December 15, 2001  
150 points

Name: _______________________________  Student Number: ____________________

Instructor: ____________________________  Section (or time): ____________________

Instructions:

*** DO NOT make any marks in the grading area (right margin.) ***

I. For full-work problems (#1 - #6), all work must be shown in order to receive credit. Your final answers should be clearly written in the blanks provided or, if no blank is provided, circled.

   II. Carry all computations to at least three decimal places unless otherwise indicated.

   III. Multiple-choice questions (#7 - #26) are worth 2.5 points each; point values are noted next to each full-work part. The entire exam is worth 150 points and counts for 30% of your course grade.

   IV. For hypothesis tests you must: Clearly state $H_0$ and $H_A$; Show the computation of the test statistic; Indicate the rejection region by drawing a picture and labeling the critical value (or compute a $p$-value); and Clearly indicate your conclusion.

   V. You may make any assumptions which are necessary to work the problems using the methods which were developed during class. However, you should not make any assumptions beyond what is necessary.

   VI. Final Exam papers are not returned to students, but you are welcome to look at your paper in your instructor’s office. Please make an appointment with him or her during the first two weeks of the Winter 2002 semester. After that time, exam papers may be destroyed.

1 of 11
1. (10 points.) In 1996, the mean monthly bill for the population of cell phone users in the United States was $47.70. A sample of 19 cell phone bills from last year was found to average $42 with a standard deviation of $14. Use the .05 level of significance to determine if the average cell phone bill decreased from 1996 to last year.

\[ H_0: \text{_________________________} \quad \text{vs.} \quad H_A: \text{_________________________} \]

Supporting work:

Should \( H_0 \) be rejected? (circle one): Yes No

2. (10 points.) A retail store claims that "80% of seasonal workers are offered a permanent job after the end of the seasonal period." A sample of 50 seasonal workers hired before last Christmas showed that 35 of them were offered a permanent job at the end of holidays. At the .05 level of significance, does it appear that the store's claim is inaccurate?

\[ H_0: \text{_________________________} \quad \text{vs.} \quad H_A: \text{_________________________} \]

Supporting work:

Should \( H_0 \) be rejected? (circle one): Yes No
3. The bathroom faucet in an older home has a tendency to drip. Suppose that the number of times that the faucet drips in a ten minute period approximately follows a Poisson distribution with $\lambda = 9$. Note that this implies that $\mu = 9$ and $\sigma = \sqrt{9} = 3$.

(a) (10 points.) What is the probability that the faucet will drip between 5 and 12 times (including both “exactly 5” and “exactly 12”) during a ten minute period?

(b) (10 points.) Suppose that the number of drips that occurred during 100 randomly selected, non-overlapping, ten minute periods were recorded. What is the probability that the AVERAGE number of drips per ten minute period in the sample will be less than 8.2?
4. Suppose that we want to determine if the average age of an MU student is different from 25. In order to do this, we will test $H_0: \mu = 25$ vs. $H_A: \mu \neq 25$. Suppose that a sample of $n = 100$ students will be collected, the population standard deviation is $\sigma = 5$, and the .05 level of significance will be used for the test.

(a) (10 points.) Write the rejection rule in terms of $x$:

Reject $H_0$ if $x < \text{________________________}$ or $x > \text{________________________}$.

(b) (10 points.) REGARDLESS OF WHAT YOU ACTUALLY GOT, suppose your answer to (a) had been: "Reject $H_0$ if $x < 24$ or $x > 26$." Use this rule to determine the probability that the researcher will commit a type II error when, in reality, $\mu = 24.5$. 

4 of 11
5. Suppose that, in a particular city, yearly family incomes are approximately normally distributed with an average of 60 thousand dollars and a standard deviation of 10 thousand dollars. An "upper class" family is defined as being one whose income is 80 thousand dollars per year or greater. Families whose income falls at or below the 1st percentile (the poorest 1% of families) are eligible for a special tax credit.

(a) (10 points.) What percentage of families in this town are classified as "upper class"?

(b) (10 points.) Families who are eligible for the "special tax credit" earn __________ thousand dollars per year or less.
6. A study was conducted to compare the amount of money owed in student loans for in-state and out-of-state students at a large, state-supported university. Data from two independent samples of recent college graduates are summarized below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean ($1000s)</th>
<th>Std. dev. ($1000s)</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-In-state</td>
<td>8</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td>2-Out-of-state</td>
<td>11</td>
<td>8</td>
<td>31</td>
</tr>
</tbody>
</table>

(a) (10 points.) At the .05 level of significance, does it appear that out-of-state students, on average, owe more on student loans than in-state students?

\[ H_0 : \text{____________________________} \quad \text{vs.} \quad H_A : \text{____________________________} \]

Supporting work:

Should \( H_0 \) be rejected? (circle one): Yes \quad No

(b) (10 points.) Conduct a test, at the .05 level, to determine whether or not the two populations have equal variances.

\[ H_0 : \text{____________________________} \quad \text{vs.} \quad H_A : \text{____________________________} \]

Supporting work:

Should \( H_0 \) be rejected? (circle one): Yes \quad No
Multiple-choice section: PRINT the letter of the best choice in the blank provided.

7. Each student in a math class owns one calculator. Fifty percent of the students own a Texas Instruments calculator and 40% own a Casio calculator. If a student is selected at random from this class, the probability that student owns a Texas Instruments calculator or a Casio calculator is

(A) .40;
(B) .50;
(C) .90;
(D) .70;
(E) None of the above choices represents a suitable response.

7. ANSWER: __________

8. If samples of \( n = 10 \) are collected from a normal population, then the sampling distribution of \( \bar{x} \) will be

(A) skewed to the left;
(B) skewed to the right;
(C) symmetric, but not approximately normal;  
(D) normal;
(E) The form of the sampling distribution can not be determined from the information provided

8. ANSWER: __________

9. If samples of \( n = 100 \) are collected from a population that is skewed to the left, then the sampling distribution of \( \bar{x} \) will be

(A) approximately normal;
(B) skewed to the right;
(C) skewed to the left;  
(D) symmetric, but not approximately normal;
(E) The form of the sampling distribution can not be determined from the information provided.

9. ANSWER: __________

10. Consider the following sample: 1, 5, 9, 10, 10. The mean, median, and mode are, respectively,

(A) 5, 9, 10;
(B) 7, 9, 10;
(C) 10, 7, 9;  
(D) 7, 7, 7;
(E) None of the above choices represents a suitable response.

10. ANSWER: __________
The following information is for questions 11 - 14: Suppose that measurements in a particular population are normally distributed with a mean of 40 and a standard deviation of 5. Note that both Chebyshev's rule and the empirical rule may be applied to this population.

11. According to Chebyshev's rule, the percentage of measurements between 30 and 50 is
   (A) approximately 75%;
   (B) at least 75%;
   (C) approximately 95%;
   (D) at least 95%;
   (E) None of the above choices represents a suitable response.

12. According to Chebyshev's rule, at least \( \frac{15}{16} \) of the measurements are between
   (A) 35 and 45;
   (B) 30 and 50;
   (C) 25 and 55;
   (D) 20 and 60;
   (E) 15 and 65.

13. According to the empirical rule, the percentage of measurements between 25 and 55 is
   (A) approximately 68%;
   (B) at least 75%;
   (C) at least 68%;
   (D) approximately 99.7%;
   (E) None of the above choices represents a suitable response.

14. According to the empirical rule, approximately 68% of measurements are between
   (A) 35 and 45;
   (B) 30 and 50;
   (C) 25 and 55;
   (D) 20 and 60;
   (E) None of the above choices represents a suitable response.
15. For a fee of $5, players are allowed to participate in a game of chance. The game involves flipping a fair coin twice. A player "wins" only if both flips come up "heads." A player who wins receives $10; a player who loses receives nothing. For a player, what is the next expected value of playing this game once?

(A) $2.50;
(B) $5.00;
(C) $10.00;
(D) -$5.00;
(E) None of the above choices represent a suitable response.

16. The empirical rule may be applied to

(A) normal populations;
(B) mound-shaped populations;
(C) highly skewed populations;
(D) both (A) and (B);
(E) None of the above choices represent a suitable response.

17. In an hypothesis test, if everything else remains the same, increasing $\alpha$ will

(A) increase $\beta$;
(B) decrease $\beta$;
(C) leave $\beta$ unchanged;
(D) decrease the power of the test;
(E) None of the above choices represent a suitable response.

18. Chebyshev's rule may be applied to populations which follow

(A) a Poisson distribution;
(B) a binomial distribution;
(C) a normal distribution;
(D) any of the above distributions;
(E) None of the above choices represent a suitable response.
19. The pooled variance estimate $s^2_p$ in the independent-samples $t$-test can be used when

(A) the two populations are assumed to have equal variances;
(B) the variances of the two populations are known;
(C) the two populations are assumed to have different variances.  
(D) the two populations are assumed to have equal means;
(E) None of the above choices represent a suitable response.

19. ANSWER: __________

20. If we wish to estimate the difference between the proportion of married female students and the proportion of married male students to within .10 of the true difference with at least 90% certainty, the minimum size of each sample is

(A) 83;
(B) 136;
(C) 193;
(D) 271;
(E) None of the above choices represent a suitable response.

20. ANSWER: __________

21. If $X$ is a binomial random variable with $n = 20$ and $\mu = 12$, then $p = _______$. 

(A) .8;
(B) .6;
(C) .4;  
(D) .2;
(E) None of the above choices represent a suitable response.

21. ANSWER: __________

22. If an hypothesis test rejects $H_0$ at $\alpha = .05$, then

(A) $H_A$ must be true;
(B) $H_A$ must be false;
(C) a type II error may have been committed;  
(D) $H_0$ would also have been rejected at $\alpha = .10$;
(E) None of the above choices represent a suitable response.

22. ANSWER: __________
The following information is for questions 23 - 26: For freshman at a particular university, the average number of classes skipped thus far this semester is 5 with a standard deviation of 2. Furthermore, suppose that 65% of freshmen have lied to their parents about their grades. For samples of size $n = 100$, consider the sampling distribution of $\hat{p}$ (the sample proportion of freshmen who have lied to their parents about their grades) and the sampling distribution of $\bar{x}$ (the sample mean number of times a freshman has skipped class).

NOTE: When necessary, the choices below have been rounded to three decimal places.

23. The sampling distribution of $\hat{p}$ will have a mean of
   (A) .35;
   (B) .002;
   (C) .65;
   (D) .048;
   (E) None of the above choices represents a suitable response.

24. The sampling distribution of $\bar{x}$ will have a mean of
   (A) 5;
   (B) 2;
   (C) 0.2;
   (D) 0.65;
   (E) None of the above choices represents a suitable response.

25. The sampling distribution of $\hat{p}$ will have a standard deviation of
   (A) 0.65;
   (B) 0.35;
   (C) 0.002;
   (D) 0.048;
   (E) 0.065.

26. The sampling distribution of $\bar{x}$ will have a standard deviation of
   (A) 0.020;
   (B) 2;
   (C) 10;
   (D) 0.065;
   (E) 0.200.