You have 150 minutes to complete this exam. Unless your exam proctor gives you alternative instructions, please observe the following:

- For the multiple choice questions, select the best answer and write it clearly in the space preceding the question number. There is only one correct answer for each question. If your instructor requires the multiple choice answers on another answer sheet (e.g. a Scantron), please place your answers there.
- For the non-multiple choice questions, provide your answers in the space provided. Show your work as appropriate.
- All problems are worth 2 points except #49, which is worth 4 points.

MULTIPLE CHOICE (40 Questions)

1. ______ A clinic gives a drug to a group of ten patients and a placebo to another group of ten patients to find out if the drug has an effect on the patients’ illness. Identify this study as an observational study or designed experiment.
   A) Designed experiment   B) Observational study

2. ______ The members of a board of directors have the following roles: President (P), Vice President (V), Secretary (S), Treasurer (T), and Fundraiser (F). The possible samples (without replacement) of size two that can be obtained from these five board members are as follows: PV, PS, PT, PF, VS, VT, VF, ST, SF, TF. If a simple random sampling method is used to obtain a sample of two of the board members, what are the chances of selecting the secretary and the treasurer together?
   A) 1/5  B) 1/10  C) 2/5  D) 1/20

3. ______ An athlete runs 100 meters in 10.7 seconds. Classify the data (the time) as either discrete or continuous.
   A) Discrete   B) Continuous

4. ______ The data in the following table represent heights of students at a high school. Find the value of the missing entry.

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>[142, 152]</td>
<td>0.03</td>
</tr>
<tr>
<td>[152, 162]</td>
<td>0.22</td>
</tr>
<tr>
<td>[162, 172]</td>
<td>0.25</td>
</tr>
<tr>
<td>[172, 182]</td>
<td>0.26</td>
</tr>
<tr>
<td>[182, 192]</td>
<td></td>
</tr>
<tr>
<td>[192, 202]</td>
<td>0.04</td>
</tr>
</tbody>
</table>

   A) 0.16   B) 0.20   C) 25%   D) Cannot be determined

5. ______ To get the best deal on a microwave oven, Jeremy called six stores and asked the cost of a specific model. The prices he was quoted are listed below. Find the range of the data set.
   $117, $511, $192, $616, $356, $313

   A) $117   B) $511   C) $499   D) $121
6. ______ A nurse measured the blood pressure of each person who visited her clinic. The following relative-frequency histogram is for the systolic blood pressure readings for 200 people between the ages 25 and 40. Approximately how many people had a systolic blood pressure reading of 140 or higher?

   Relative Frequency
   0.35
   0.30
   0.25
   0.20
   0.15
   0.10
   0.05
   0.00
   100 110 120 130 140 150 160
   Systolic Blood Pressure (mm Hg)

A) 35   B) 8   C) 22   D) 11

7. ______ A frequency histogram is given below for the weights of a sample of college students. Which of the following best describes the overall shape of the distribution?

   Frequency
   220
   200
   180
   160
   140
   120
   100
   80
   60
   40
   20
   0
   105 110 115 120 125 130 135 140 145 150 155 160
   Weight (pounds)

A) Bimodal  B) Multimodal  C) Bell-shaped  D) Uniform

8. ______ For the same frequency histogram given above in #7, which of the following best describes the skew of the distribution?
A) Left skewed  B) Symmetric  C) Right skewed

9. ______ Bill kept track of the number of hours he spent exercising each week. The results for four months are shown below. Find the mean number of hours Bill spent exercising per week.

   6.6, 7.3, 7.5, 7.5, 7.9, 8.1, 8.1, 8.1, 8.3
   8.3, 8.6, 8.6, 8.6, 8.6, 8.7, 8.7, 8.7, 8.7

A) 8.39 hr  B) 8.64 hr  C) 7.73 hr  D) 8.16 hr

10. ______ For the same data given above in #9, find the median number of hours Bill spent exercising per week.
A) 8.1 hr  B) 8.2 hr  C) 8.3 hr  D) 8.45 hr

11. ______ Christine is currently taking college astronomy. The instructor often gives quizzes. On the past seven quizzes, Christine got the following scores. Find the sample standard deviation.

   52, 15, 48, 27, 12, 42, 68

A) 9956.6   B) 20.6   C) 48   D) 12,494
12. Here are 3 boxplots of weekly gas prices at a local service station (price in $ per gallon). Compare the distributions of prices over the three years, and select the best description.

A) Gas prices have been increasing on average over the 3-year period, and the variation overall has been increasing as well. The distribution has been right-skewed.

B) Gas prices have been decreasing on average over the 3-year period, but the variation in the middle 50% has been increasing while the variation for the entire distribution has decreased. The distribution has been right-skewed.

C) Gas prices have been increasing on average over the 3-year period, but the variation in the middle 50% has decreased while the variation for the entire distribution has increasing. The distribution has been left-skewed.

13. The mean of a data set is 126.02 and its standard deviation is 89.34. Find the z-score for a value of 386.67.

A) 2.92   B) 3.22   C) 3.21   D) 2.63

14. Determine which scatterplot shows the strongest linear correlation.
15. A frequency distribution on employment information from Alpha Corporation follows. Find the probability that a randomly chosen employee has been with the company 10 years or less.

<table>
<thead>
<tr>
<th>Years Employed</th>
<th>No. of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>5</td>
</tr>
<tr>
<td>6-10</td>
<td>30</td>
</tr>
<tr>
<td>11-15</td>
<td>25</td>
</tr>
<tr>
<td>16-20</td>
<td>10</td>
</tr>
<tr>
<td>21-25</td>
<td>5</td>
</tr>
<tr>
<td>26-30</td>
<td>3</td>
</tr>
</tbody>
</table>

A) 0.294  B) 0.735  C) 0.551  D) 0.449

16. For a randomly selected student in a particular high school, let Y denote the number of living grandparents of the student. What are the possible values of the random variable Y?
A) 1, 2, 3, 4  B) 0, 1, 2, 3, 4  C) 4  D) 0, 1, 2

17. The random variable X is the number that shows up when a loaded die is rolled. Its probability distribution is given in the table below. Find the mean of the random variable X.

<table>
<thead>
<tr>
<th>x</th>
<th>P(X=x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.16</td>
</tr>
<tr>
<td>2</td>
<td>0.11</td>
</tr>
<tr>
<td>3</td>
<td>0.13</td>
</tr>
<tr>
<td>4</td>
<td>0.13</td>
</tr>
<tr>
<td>5</td>
<td>0.10</td>
</tr>
<tr>
<td>6</td>
<td>0.37</td>
</tr>
</tbody>
</table>

A) 3.50  B) 0.17  C) 4.01  D) 3.88

18. Determine the binomial probability given the number of trials and the success probability for Bernoulli trials. Let X denote the total number of successes. n = 5, p = 0.6, P(X=2).
A) 0.360  B) 0.300  C) 0.230  D) 0.346

19. Dave drives to work each morning at about the same time. His commute time is normally distributed with a mean of 51 minutes and a standard deviation of 5 min. The percentage of time that his commute time exceeds 58 minutes is equal to the area under the standard normal curve that lies to the ____ of ____.
A) left, 1.4  B) right, 1.4  C) right, 7  D) left, 1

20. Use a table of areas to find the specified area under the standard normal curve: the area that lies between -0.73 and 2.27.
A) 0.2211  B) 0.7557  C) 0.4884  D) 1.54

21. Find the z-score having area 0.86 to its right under the standard normal curve; that is, find z_{0.86}.
A) 1.08  B) -1.08  C) 0.8051  D) 0.5557

22. The diameters of bolts produced by a certain machine are normally distributed with a mean of 0.30 inches and a standard deviation of 0.01 inches. What percentage of bolts will have a diameter greater than 0.32 inches?
A) 97.72%  B) 47.72%  C) 37.45%  D) 2.28%

23. What generally happens to the sampling distribution of the sample mean as the sample size is decreased?
A) It becomes less tightly concentrated around the population mean.
B) It is unaffected.
C) It becomes more tightly concentrated around the population mean.
D) None of the above.
24. The National Weather Service keeps records of snowfall in mountain ranges. Records indicate that in a certain range, the annual snowfall has a mean of 106 inches and a standard deviation of 10 inches. Suppose the snowfalls are sample during randomly picked years. For samples of size 25, determine the mean and standard deviation of $\bar{x}$.

A) $\mu_{\bar{x}} = 2$; $\sigma_{\bar{x}} = 106$  
B) $\mu_{\bar{x}} = 106$; $\sigma_{\bar{x}} = 2$  
C) $\mu_{\bar{x}} = 106$; $\sigma_{\bar{x}} = 10$  
D) $\mu_{\bar{x}} = 10$; $\sigma_{\bar{x}} = 106$

25. The mean height for a population is 65 inches. Let $\bar{x}$ denote the mean height for a sample of people picked randomly from the population. True or False, the standard deviation of $\bar{x}$ for samples of size 30 is smaller than the standard deviation, $\sigma$, of the population?

A) True  B) False

26. Let $x$ represent the number that shows up when a balanced six-sided die is rolled. Then $x$ is a random variable with a mean of 3.5 and a standard deviation of 1.71. Let $\bar{x}$ denote the mean of the numbers obtained when the die is rolled 40 times. Determine the sampling distribution of $\bar{x}$.

A) Approximately normal, mean = 3.5, standard deviation = 1.71.  
B) Approximately normal, mean = 3.5, standard deviation = 0.27.  
C) Normal, mean = 3.5, standard deviation = 0.27.  
D) Normal, mean = 3.5, standard deviation = 0.04

27. The amount of coffee that a filling machine puts into an 8-ounce jar is normally distributed with a mean of 8.2 ounces and a standard deviation of 0.18 ounce. What is the probability that the sampling error made in estimating the mean amount of coffee for all 8-ounce jars by the mean of a random sample of 100 jars will be at most 0.02 ounce?

A) 0.7330  B) 0.8665  C) 0.0938  D) 0.0876

28. In stating a confidence-interval estimate of a population mean, the level of confidence increases as the size of the interval ______.

A) increases  B) decreases

29. The monthly earnings of a group of business students are normally distributed with a standard deviation of approximately 545 dollars. A researcher wants to estimate the mean monthly earnings of all business students. Find the sample size needed to have a confidence level of 95% and a margin of error of 128 dollars.

A) 5  B) 2  C) 61  D) 70

30. For a $t$-curve with $df=24$, find $t_{0.005}$.

A) 1.711  B) 2.807  C) 2.797  D) 2.492

31. A sociologist develops a test to measure attitudes about public transportation, and 27 randomly selected subjects are given the test. Their mean score is 76.2 and their standard deviation is 21.4. Construct the 95% confidence interval for the mean score of all such subjects. Assume that the population is normally distributed.

A) 69.2 to 83.2  B) 67.7 to 84.7  C) 64.2 to 88.2  D) 74.6 to 77.8

32. Determine the critical value(s) for a one-mean $z$-test if it is a left-tailed test with $\alpha = 0.04$.

A) -1.75  B) -2.05  C) 2.05  D) 1.75

33. The significance level of a hypothesis test is $\alpha = 0.01$, and the $p$-value is calculated to be $p$-value = 0.002. Decide whether the null hypothesis should be rejected.

A) Reject the null hypothesis  B) Do not reject the null hypothesis
The mean credit card debt among households in one state is $8400. A hypothesis test is to be performed to decide whether the mean credit card debt for households in the formerly affluent town of Rich-No-More differs from the mean credit card debt for the state. The hypotheses are

\[ H_0: \mu = 8400 \quad \text{and} \quad H_a: \mu \neq 8400 \]

Where \( \mu \) is the mean credit card debt for all households in Rich-No-More. Explain the meaning of a correct decision.

A) A correct decision would occur if, in fact, \( \mu = 8400 \), and the results of the sampling do not lead to rejection of that fact; or if, in fact, \( \mu \neq 8400 \) and the results of the sampling lead to that conclusion.
B) A correct decision would occur if, in fact, \( \mu = 8400 \), and the results of the sampling do not lead to rejection of that fact; or if, in fact, \( \mu \neq 8400 \) and the results of the sampling do not lead to rejection of the null hypothesis that \( \mu = 8400 \).
C) A correct decision would occur if, in fact, \( \mu = 8400 \), but the results of the sampling lead to the conclusion that \( \mu \neq 8400 \); or if, in fact, \( \mu \neq 8400 \) and the results of the sampling lead to that conclusion.
D) A correct decision would occur if, in fact, \( \mu \neq 8400 \), and the results of the sampling do not lead to rejection of the null hypothesis that \( \mu = 8400 \).

Use a table of t-values to estimate the p-value for the specified one-mean t-test: left-tailed test, \( n = 15 \), \( t = -2.671 \).

A) \( 0.005 < P < 0.01 \)  
B) \( 0.01 < P < 0.025 \)  
C) \( P < 0.005 \)  
D) \( P > 0.005 \)

A researcher wants to perform a hypothesis test to determine whether the mean credit card debt for credit card holders aged 18-35 is greater than the mean credit card debt for credit card holders aged over 35. Determine the appropriate null and alternative hypothesis for this proposed hypothesis test. Let \( \bar{x}_1 \) and \( \bar{x}_2 \) denote the sample mean credit card debt for credit card holders aged 18-35 and over 35, respectively. Let \( \mu_1 \) and \( \mu_2 \) denote the population mean credit card debt for credit card holders aged 18-35 and over 35, respectively.

A) \( H_0: \bar{x}_1 = \bar{x}_2 \) and \( H_a: \bar{x}_1 > \bar{x}_2 \)  
B) \( H_0: \mu_1 > \mu_2 \) and \( H_a: \mu_1 < \mu_2 \)  
C) \( H_0: \mu_1 = \mu_2 \) and \( H_a: \mu_1 < \mu_2 \)  
D) \( H_0: \mu_1 = \mu_2 \) and \( H_a: \mu_1 > \mu_2 \)

Summary statistics are given for independent random samples from two population. Use the nonpooled t-interval procedure to obtain a 95% confidence interval for \( \mu_1 - \mu_2 \).

\[ \bar{x}_1 = 73.9, \ s_1 = 10.9, \ n_1 = 16, \ \bar{x}_2 = 68.5, \ s_2 = 8.2, \ n_2 = 12 \]

A) -2.35 to 13.15  
B) -2.33 to 13.13  
C) -2.04 to 12.84  
D) -2.24 to 13.04

Suppose \( x \) is a variable on each of two population whose members can be paired and that a paired difference is the difference between the values of the variable \( x \) on the members of a pair. True or false: The mean of the paired differences equals the difference between the two population means?

A) True  
B) False

The number of successes and the sample size are given for a simple random sample from a population. Decide if using the one-proportion z-interval procedure is appropriate: \( x = 86, \ n = 90 \).

A) Not appropriate  
B) Appropriate

The numbers of successes and the sample sizes are given for independent simple random samples from two population. Use the two-proportions z-test to conduct the two-tailed hypothesis test of \( H_0: p_1 = p_2 \) using the critical-value approach.

\[ x_1 = 16, \ n_1 = 20, \ x_2 = 42, \ n_2 = 60, \ \alpha = 0.05 \]

A) \( z = 0.87 \), critical values = \( \pm 1.96 \), reject \( H_0 \)  
B) \( z = 0.87 \), critical values = \( \pm 1.96 \), do not reject \( H_0 \)  
C) \( z = 0.78 \), critical values = \( \pm 1.96 \), reject \( H_0 \)  
D) Two-proportions z-test is not appropriate
SHORT ANSWER (9 Questions)

41. The following table gives the distribution of land (in acres) for a county containing 86,000 acres. Construct a pie chart representing the data. (Be sure it is well-labeled.)

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Acres</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>12,900</td>
<td>0.15</td>
</tr>
<tr>
<td>Farm</td>
<td>8,600</td>
<td>0.10</td>
</tr>
<tr>
<td>Urban</td>
<td>64,500</td>
<td>0.75</td>
</tr>
</tbody>
</table>

42. The test scores of 20 students are listed below. Find the third quartile, Q₃.

36, 45, 49, 53, 55, 56, 59, 61, 62, 65
69, 70, 74, 78, 84, 87, 89, 93, 98, 100

Q₃ =

Show work:

43. From a finite sample, events A and B are non-mutually exclusive. In the Venn diagram below, shade the event “A and B”.

44. In one city, 51.1% of adults are female, 10.2% of adults are left-handed, and 5.1% are left-handed females. For an adult selected at random from the city, let F = event the person is female, and L = event the person is left-handed. Find P(F or L). Round your answer to three decimal places.

P(F or L) =
45. The annual precipitation for one city is normally distributed with a mean of 340 inches and a standard deviation of 3.8 inches. In 95.44% of the years, the precipitation in this city is between _______ inches and _______ inches (assuming equal tail probabilities).

Show work:

46. Suppose a confidence interval is 9.65 < μ < 11.35. Find the sample mean \( \bar{x} \) and the margin of error \( E \).

\( \bar{x} = \) _______  

\( E = \) _______

Show work:

47. The value obtained for the test statistic in a one-mean two-tailed z-test is \( z = 1.31 \). Determine the P-value.

\( P = \) _______

Show work:

48. A hypothesis test is to be performed for a population proportion. Out of 125 observations, 54% were successes. If \( H_0: p = 0.48 \) is to be tested, calculate the value of the test statistic \( z = \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} \).

\( z = \) _______

Show work:

49. (4 Points) DuraBurn claims that the mean lifetime of its SuperGlow light bulbs is 904 hours. A researcher wants to perform a hypothesis test to determine whether the mean lifetime is actually less than this. A random sample of \( n = 10 \) DuraBurn SuperGlow bulbs exhibited an average lifetime \( \bar{x} = 810 \) with a standard deviation \( s = 158 \) hours. State the appropriate hypotheses, compute the value of the test statistic, find the p-value, and state your conclusion using a significance level of 0.05. Assume the population is normal.

Hypotheses: _______  

Test statistic: _______

P-value: _______

Conclusion: _______

Show work: