Use the following for questions 1 - 3.

The education cost per student (in thousands of dollars) from a sample of 8 math departments is

\[20 \quad 22 \quad 25 \quad 19 \quad 30 \quad 35 \quad 28 \quad 25\]

1. The sample mean is equal to

(a) 5.4  
(b) 25  
(c) 28.80  
(d) 25.50  
(e) 16

2. The median of the sample is equal to

(a) 25  
(b) 25.50  
(c) 35  
(d) 19  
(e) 10

3. The sample standard deviation is about

(a) 5.4  
(b) 25  
(c) 28.8  
(d) 25.5  
(e) 16
Use the following for questions 4 - 6.

The following table shows the results of a survey that asked 185 students whether they liked the game of chess.

<table>
<thead>
<tr>
<th></th>
<th>Likes chess</th>
<th>Dislikes chess</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>40</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>60</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If a student is chosen at random from the sample,

4. The probability that the student likes chess is about

(a) 0.50  
(b) 0.54  
(c) 0.53  
(d) 0.55  
(e) 0.63

5. The probability that the student is a female or likes chess is about

(a) 0.73  
(b) 0.54  
(c) 0.27  
(d) 0.53  
(e) 0.39

6. The student is a male and likes chess is about

(a) 0.32  
(b) 0.54  
(c) 0.27  
(d) 0.45  
(e) 0.15
Use the following for questions 7 and 8.

*Students Who Care* is a student volunteer program in which college students donate work time to various community projects such as planting trees. The faculty sponsor of this program reports that the mean number of hours volunteered by students is 29.1 hours per semester with a standard deviation of 1.7 hours per semester.

7. Each semester, at least 75% of students in this program volunteer between

(a) 27.4 and 32.5 hours
(b) 24.0 and 34.2 hours
(c) 25.7 and 32.5 hours
(d) 24.8 and 33.3 hours
(e) 35.9 and 22.3 hours

8. If we assume that the number of hours volunteered by students in this program is bell-shaped, then each semester, approximately 68% of students in this program volunteer between

(a) 27.4 and 30.8 hours
(b) 24.0 and 34.2 hours
(c) 25.7 and 32.5 hours
(d) 24.8 and 33.3 hours
(e) 35.9 and 22.3 hours

Use the following for questions 9 - 11.

Scores on a previous common final exam for Stat 1222 were normally distributed with a mean of 71 and a standard deviation of 9.

9. The probability that a randomly selected student scored at least 77 in the exam is about

(a) 0.97
(b) 0.67
(c) 0.25
(d) 0.14
(e) 0.75
10. The probability that a randomly selected student scored between 53 and 80 is about
   (a) 0.98
   (b) 0.82
   (c) 0.02
   (d) 0.86
   (e) 0.50

11. If the Department’s policy is to assign an A to the top 10% of the students in the course, the lowest exam score to be awarded an A is about
   (a) 89
   (b) 81
   (c) 82.5
   (d) 59.5
   (e) 90

Use the following for questions 12 - 14.
A sociologist surveyed the households in a small town in North Carolina. The probability distribution of $x$, the number of dependent children in the household was computed to be given by

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(x)$</td>
<td>?</td>
<td>0.20</td>
<td>0.38</td>
<td>0.22</td>
<td>0.13</td>
</tr>
</tbody>
</table>

12. Find $P(0)$.
   (a) 0.16
   (b) 0.93
   (c) 1.00
   (d) 0.07
   (e) 0.00

13. The average number of dependent children in the households is about
   (a) 3
   (b) 4.3
   (c) 2.5
   (d) 2.23
   (e) 2.14
14. The probability that a randomly selected household had at least two dependent children is
(a) 0.38
(b) 0.73
(c) 0.27
(d) 0.10
(e) 0.88

15. A wildlife study is designed to find the mean weight of salmon caught by an Alaskan fishing company. Find the minimum sample size needed in order to construct a 95% confidence interval for the mean weight of such salmon, to within 0.20 pounds. Assume that \( \sigma = 2.10 \)
(a) 770
(b) 424
(c) 420
(d) 301
(e) 652

16. The critical value \( z_c \) corresponding to a confidence level of \( c = 99.6\% \) is equal to
(a) \( z_c = 2.01 \)
(b) \( z_c = 1.96 \)
(c) \( z_c = 2.88 \)
(d) \( z_c = 2.65 \)
(e) \( z_c = 3.30 \)

17. A random sample of 100 observations from a population yields a mean equal to 10 and a standard deviation equal to 6. A 90% confidence interval for the mean of the population is
(a) 10 ± 0.9870
(b) 10 ± 1.0248
(c) 10 ± 1.0266
(d) 10 ± 1.1760
(e) None of these.
Use the following for questions 18 - 20.

The systolic blood pressures of 7 patients before taking a new drug and two hours after taking the drug are shown in table below.

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>103</td>
<td>122</td>
<td>108</td>
<td>112</td>
<td>125</td>
<td>97</td>
<td>107</td>
</tr>
<tr>
<td>After</td>
<td>98</td>
<td>121</td>
<td>105</td>
<td>105</td>
<td>110</td>
<td>89</td>
<td>100</td>
</tr>
</tbody>
</table>

Assume that the blood pressures before and after taking the drug are approximately normally distributed.

Let

\[ d = \text{Blood pressures before} - \text{Blood pressures after} \]

and let \( \mu_d \) denote the mean of the differences.

18. Choose the appropriate null and alternative hypotheses to test whether the drug is effective in reducing blood pressure.

(a) \( H_0 : \mu_d \geq 0 \) versus \( H_a : \mu_d < 0 \).
(b) \( H_0 : \mu_d \leq 0 \) versus \( H_a : \mu_d > 0 \).
(c) \( H_0 : \mu_d = 0 \) versus \( H_a : \mu_d \neq 0 \).
(d) \( H_0 : d \leq 0 \) versus \( H_a : d > 0 \).
(e) \( H_0 : \mu_d < 0 \) versus \( H_a : \mu_d \geq 0 \).

19. The value of the standardized test statistic is closest to

(a) 6.60
(b) 0.55
(c) 3.89
(d) -2.5
(e) 5.40

20. Using the significance level, \( \alpha = .05 \), identify the rejection region and state your decision.

(a) Rejection Region: \( t < -2.447 \); Decision: Fail to reject \( H_0 \)
(b) Rejection Region: \( t > 2.447 \); Decision: Reject \( H_0 \)
(c) Rejection Region: \( t < -1.943 \); Decision: Reject \( H_0 \)
(d) Rejection Region: \( t > 1.943 \); Decision: Reject \( H_0 \)
(e) Rejection Region: \( t < 1.943 \); Decision: Fail to reject \( H_0 \)
21. Consider testing $H_0 : \mu = 100$ versus $H_a : \mu \neq 100$. We commit a Type I error if we reject $H_0$ when in fact $\mu = 100$. We commit a Type II error if

(a) we reject $H_0$ when in fact $\mu \neq 100$.
(b) we reject $H_0$ when in fact $\mu = 100$.
(c) we fail to reject $H_0$ when in fact $\mu = 100$.
(d) we fail to reject $H_0$ when in fact $\mu \neq 100$.
(e) None of the above

22. A paint manufacturer wants to determine the average drying time of a new interior wall paint. For a random sample of 12 test areas of equal size, he obtained a mean drying time of 66.3 minutes with a standard deviation of 8.4 minutes. Assume that the population of drying times is normally distributed. A 95% confidence interval for the true mean drying time $\mu$ is closest to.

(a) (60.96, 71.64)
(b) (61.54, 71.05)
(c) (60.27, 71.87)
(d) (60.00, 72.00)
(e) (59.97, 72.01)

23. The National Council of Small Businesses wishes to construct a 95% confidence interval for the proportion of small businesses that declared Chapter 11 bankruptcy last year, to within 0.10. If no preliminary estimate of the true proportion is available, the National Council must choose a sample of size at least:

(a) $n = 40$
(b) $n = 110$
(c) $n = 68$
(d) $n = 97$
(e) $n = 67$
Use the following for questions 24 - 27.

A team of eye surgeons has developed a new technique for a risky eye operation to restore the sight of people blinded from a certain disease. Under the old method, it is known that only 30% of the patients who undergo this operation recover their eyesight. Suppose that in a random sample of 225 operations performed by surgeons in various hospitals, 88 patients have fully recovered their eyesight.

24. Can we justify the claim that the new technique is better than the old one? State the null and alternative hypotheses to test such a claim.

(a) $H_0: p \geq .30$ against $H_a: p < .30$
(b) $H_0: p = .30$ against $H_a: p \neq .30$
(c) $H_0: p < .30$ against $H_a: p \geq .30$
(d) $H_0: p \leq .30$ against $H_a: p > .30$
(e) None of these

25. The value of the standardized test statistic is closest to

(a) $z = -2.95$
(b) $z = 3.18$
(c) $z = 2.95$
(d) $z = 2.76$
(e) $z = 1.93$

26. Find the $p$-value for the test.

(a) 0.0531
(b) 0.0314
(c) 0.0016
(d) 0.9984
(e) 0.0007

27. With $\alpha = .01$, which of the following is the correct decision?

(a) Reject $H_0$ because the $p$-value is less than $\alpha$.
(b) Do not reject $H_0$ because the $p$-value is less than $\alpha$.
(c) Reject $H_0$ because the $p$-value is greater than $\alpha$.
(d) Do not reject $H_0$ because the $p$-value is greater than $\alpha$.
(e) Do not reject $H_0$ because because $\alpha$ is less than the $p$-value.
28. Isabel Myers was a pioneer in the study of personality types. In a study of personality types, researchers took a random sample of 519 judges and found that 285 of them were introverts. Letting \( p \) represent the proportion of all judges that are introverts, a 99% confidence interval for \( p \) is closest to

(a) (0.61, 0.74)
(b) (0.49, 0.61)
(c) (0.51, 0.58)
(d) (0.57, 0.65)
(e) (0.45, 0.53)
(f) None of these

Use the following for questions 29 - 30.

Do larger universities tend to have more property crime? University crime statistics are affected by a variety of factors such as surrounding community, accessibility given to outside visitors, etc. Let \( x \) represent student enrollment (in thousands) and let \( y \) represent the number of burglaries in a year on the university campus. A random sample of \( n = 8 \) universities in California yielded the following data regarding the enrollments and annual burglary incidents.

<table>
<thead>
<tr>
<th>( x )</th>
<th>12.5</th>
<th>30.0</th>
<th>24.5</th>
<th>14.3</th>
<th>7.5</th>
<th>27.7</th>
<th>16.2</th>
<th>20.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>26</td>
<td>73</td>
<td>39</td>
<td>23</td>
<td>15</td>
<td>30</td>
<td>15</td>
<td>25</td>
</tr>
</tbody>
</table>

The equation of the regression line relating \( y \) to \( x \) as well as the coefficient of correlation are computed to be

\[
\hat{y} = -4.13 + 1.83x; \quad r = 0.76
\]

29. The predicted number of annual burglary incidents for a California university with 23 (thousands) students is about

(a) 46
(b) 32.3
(c) 38
(d) 27
(e) 42
30. Which of the following statements are correct?

I. The regression line indicates that the annual burglary incidents tend to increase as the enrollment on a California university campus increases.

II. There is a strong negative correlation between the variables $x$ and $y$.

III. There is a moderately strong positive correlation between the variables $x$ and $y$.

IV. It is appropriate to use this regression equation to predict the number of annual burglary incidents even for $x = 4$.

a. II and IV
b. I only
c. I and III only
d. III only
e. All are correct
1. The following table gives information on the income (in thousands of dollars), \( x \), and charitable contributions (in hundreds of dollars), \( y \), in a year for a random sample of 10 households.

<table>
<thead>
<tr>
<th>Income ( x )</th>
<th>Contribution ( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>10</td>
</tr>
<tr>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>102</td>
<td>29</td>
</tr>
<tr>
<td>72</td>
<td>23</td>
</tr>
<tr>
<td>52</td>
<td>3</td>
</tr>
<tr>
<td>91</td>
<td>28</td>
</tr>
<tr>
<td>50</td>
<td>8</td>
</tr>
<tr>
<td>62</td>
<td>16</td>
</tr>
<tr>
<td>80</td>
<td>18</td>
</tr>
<tr>
<td>40</td>
<td>2</td>
</tr>
</tbody>
</table>

\[
\sum x = 641 \quad \sum y = 141 \quad \sum xy = 10934 \\
\sum x^2 = 45349 \quad \sum y^2 = 2927
\]

(a) Assuming that there exists a linear relationship between \( y \) and \( x \), find the equation of the regression line. (3 pts)

(b) Calculate the correlation coefficient \( r \) and the coefficient of determination \( r^2 \). Interpret the coefficient of determination in the context of the problem. (3 pts)

(c) Find the standard error of estimate \( s_e \). (2 pts)

(d) Predict the amount of charitable contribution of a household with an income of \( x = 60 \). (2 pts)

(e) Construct a 95\% prediction interval for \( y \) when \( x = 60 \). (5 pts)
2. An experiment is performed to determine whether the average nicotine content of Brand I cigarettes equals that of Brand II. A random sample of $n_1 = 50$ cigarettes of Brand I yielded an average nicotine content of $\bar{x}_1 = 2.61$ milligrams with a standard deviation of $s_1 = 0.12$ milligram, whereas a random sample of $n_2 = 40$ cigarettes of Brand II yielded an average nicotine content of $\bar{x}_2 = 2.58$ milligrams with a standard deviation of $s_2 = 0.14$ milligram.

(a) State the null and alternative hypotheses to test whether there is a difference in the nicotine content of the two brands. (3 pts)

(b) Calculate the value of the standardized test statistic. (4 pts)

(c) Find the $p$-value of the test statistic. (3 pts)

(d) At significance level $\alpha = 5\%$, is there sufficient evidence to conclude that there is a difference in the nicotine content of the two brands? State your decision. (3 pts)
3. A company wanted to know if attending a course on "how to be a successful salesperson" can increase the average sales of its employees. The company sent 6 of its salespersons to attend this course. The following table gives the one-week sales of the six employees before and after they attended the course.

<table>
<thead>
<tr>
<th>Before</th>
<th>12</th>
<th>18</th>
<th>25</th>
<th>9</th>
<th>14</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>After</td>
<td>18</td>
<td>24</td>
<td>24</td>
<td>14</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>

Let

\[ d = \text{Weekly sales before the course} - \text{Weekly sales after the course} \]

and let \( \mu_d \) denote the population difference. Assume that the population of paired differences has a normal distribution.

(a) State the null and alternative hypotheses to test whether the mean weekly sales for all salespersons has increased. (3 pts)

\[ H_0 : \quad H_\alpha : \]

(b) Find the value of the standardized test statistic based on the observed data. (5 pts)

(c) Using \( \alpha = .05 \), determine the critical value and the rejection region. State your conclusion and interpret it in the context of the problem. (4 pts)