PLEASE PRINT THE FOLLOWING INFORMATION:

Name: ___________________________ Instructor: ________________________________

Student ID #: ____________________ Section/Time: ____________________________

THIS EXAM HAS TWO PARTS.

PART I.
Part I consists of 30 multiple choice questions. Each correct answer is scored 2 points; each incorrect (or blank) answer is scored 0, so there is no penalty for guessing. You may do calculations on the test paper, but your answers must be marked on the OPSCAN sheet with a soft lead pencil (HB or No. 2 lead). Any question with more than one choice marked will be counted as incorrect. If more than one choice seems correct, choose the one that is most complete or most accurate. Make sure that your name and ID number are written and correctly bubbled on the OPSCAN sheet.

PART II.
Part II consists of 3 free response questions, with values as indicated. You must show all work in the space provided or elsewhere on the exam paper in a place that you clearly indicate. Work on loose sheets will not be graded.

FOR DEPARTMENT USE ONLY:

Part II.

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<th>1</th>
<th>2</th>
<th>3</th>
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<td>Score</td>
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<tr>
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Part I

Problems 1 through 3 pertain to the following sample data:
0, −3, 7, −2, 5, 4, 12, 1, 6

1. The mean of this data set is about
   (a) 5.0 (b) 4.4 (c) 9.0 (d) 3.3 (e) 4.0

2. The median of this data set is
   (a) 4.4 (b) 4 (c) 5 (d) 4.5 (e) 3.3

3. The sample standard deviation of this data set is about
   (a) 23 (b) 3.64 (c) 4.80 (d) 3.44 (e) 4.52

4. The standard deviation of a numerical data set measures the ______ of the data.
   (a) range (b) average (c) most frequent value (d) variability (e) size

Problems 5 and 6 pertain to the following information:
The distribution of the body temperatures of adults is roughly bell-shaped, with a mean of 98.6 degrees Fahrenheit and a standard deviation of 0.8 degrees Fahrenheit.

5. The proportion of adults whose body temperature is above 98.6 degrees is about
   (a) .99 (b) .58 (c) .68 (d) .95 (e) .50

6. The proportion of adults whose body temperature is between 97.0 and 100.2 degrees is about
   (a) .95 (b) .50 (c) .68 (d) 1.00 (e) .975
7. A mother is told that the length of her one year old son, 31.5 inches, places him at the 80th percentile for length of boys. This means that

(a) About 80% of all one year old boys are longer than he is.
(b) The standard score (z-score) of her son’s height is 0.80.
(c) He is 80 centimeters long.
(d) About 80% of all one year old boys are shorter than he is.
(e) None of the above.

Problems 8 and 9 pertain to the following situation:

A player in a game rolls a normal die (that is, a six-sided cube with between one and six dots on each face, a different number of dots on each face) and flips a fair coin (that is, heads and tails come up with equal likelihood).

8. The probability that either the coin is heads or the die shows a number greater than four is about

(a) .50 (b) .67 (c) .75 (d) .33 (e) .17

9. The probability that both the coin is heads and the die shows a number greater than four is about

(a) .33 (b) .75 (c) .17 (d) .67 (e) .50

Problems 10 and 11 pertain to the following situation:

The table shows the nature of the injuries sustained by soccer players in a college athletic conference one year that resulted in loss of playing time. Injuries are classified according to severity of the injury and the condition under which it was sustained.

<table>
<thead>
<tr>
<th></th>
<th>Minor</th>
<th>Moderate</th>
<th>Serious</th>
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</thead>
<tbody>
<tr>
<td>Practice</td>
<td>48</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Game</td>
<td>62</td>
<td>32</td>
<td>17</td>
</tr>
</tbody>
</table>

10. The probability that a randomly selected injury that resulted in loss of playing time is serious is about

(a) 12% (b) 17% (c) 62% (d) 23% (e) 6%

11. The probability that a randomly selected injury is serious, given that it occurred in practice, is about

(a) 17% (b) 23% (c) 12% (d) 40% (e) 8%
Problems 12 and 13 pertain to the following situation:

The number \( x \) of errors on a randomly selected page of a textbook has the following probability distribution. No page has more than four errors.

<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>.90</td>
<td>.06</td>
<td>.03</td>
<td>.005</td>
<td>.005</td>
</tr>
</tbody>
</table>

12. The probability that a randomly selected page contains at least one error is about

(a) 0.04   (b) 0.90   (c) 0.06   (d) 0.10   (e) 0.96

13. The average number of errors per page is about

(a) 10   (b) .155   (c) .20   (d) 1.55   (e) .06

14. A basketball player makes 70% of his free throws. If he is awarded 20 free throws, then the probability that he will make between 12 and 16 of them (including 12 and 16) is about

(a) .14   (b) .78   (c) .70   (d) .53   (e) .22

15. A man buys twenty $1 lottery tickets per week. The chance of buying a winning ticket is 5%. The average number of winning tickets that he buys per week is

(a) 8   (b) 0   (c) 5   (d) 1   (e) 15

In Problems 16 and 17, \( z \) denotes the standard normal random variable.

16. \( P(z \geq 1.07) \) is approximately

(a) 0.6423   (b) .4554   (c) .0446   (d) .3577   (e) .1423

17. \( P(-0.27 \leq z \leq 1.21) \) is approximately

(a) .4933   (b) .5067   (c) .2805   (d) .3869   (e) .9067
18. Fuel economy of compact cars is normally distributed with a mean of 32.2 miles per gallon and a standard deviation of 3.7 miles per gallon. The probability that a randomly selected compact car gets at least 40 miles per gallon is about

(a) .9826  (b) .2108  (c) .0174  (d) .4312  (e) .5174

19. Annual household incomes in a certain region have a distribution that is skewed right, with mean 30.25 thousand dollars and a standard deviation of 4.50 thousand dollars. If a random sample of 100 households is taken, then the probability that the sample mean \( \bar{x} \) will be within one thousand dollars of the true population mean is about

(a) 17%  (b) 97%  (c) 76%  (d) 49%  (e) 9%

20. Last year times by runners in a footrace were normally distributed with mean 36 minutes and standard deviation 2.5 minutes. Race organizers wish to predict the smallest time \( T \) such that 95% of the runners will have finished the race by time \( T \). Based on last year’s results, that time \( T \) is about

(a) 49.4 min  (b) 43.5 min  (c) 37.0 min  (d) 40.1 min  (e) 38.6 min

21. A librarian at a public library wishes to construct a 95% confidence interval for the mean amount of time patrons use library computers with access to the internet. He will do so by examining a random sample of logged times, and he wants the result to give the mean to within 1 minute. If the standard deviation of times is estimated to be about 10 minutes, then he must choose a sample of size at least

(a) 48  (b) 196  (c) 385  (d) 20  (e) 273

22. Twelve volunteers were given an experimental drug for inducing sleep, and the time \( x \) in minutes until each person fell asleep was recorded. The results were \( \bar{x} = 20.2 \) and \( s = 5.32 \). Assuming that the population of times is normally distributed, a 90% confidence interval for the mean time until a person taking this drug falls asleep, for all adults, is

(a) 20.2 ± (1.796) \( \frac{5.32}{\sqrt{12}} \)
(b) 20.2 ± (1.645) \( \frac{5.32}{\sqrt{12}} \)
(c) 20.2 ± (1.782) \( \frac{5.32}{\sqrt{12}} \)
(d) 20.2 ± (1.363) \( \frac{5.32}{\sqrt{12}} \)
(e) 20.2 ± (1.282) \( \frac{5.32}{\sqrt{12}} \)
23. To test the effect of smoking on the mean IQ of children, a study was done in which the cognitive ability of 25 children, four years of age, who lived in a home with an adult smoker was measured, and independently the cognitive ability of 25 children, four years of age, growing up in a home without anyone who smokes was measured. Assuming that the populations of the IQ scores of both populations of four year olds are normally distributed, and that presence of a smoker had no effect on the standard deviations of the children’s IQ scores, the appropriate formula to use to construct a confidence interval for the difference in the mean scores of the two populations of children is

\[ (\bar{x}_1 - \bar{x}_2) \pm t \sqrt{s_p \left( \frac{1}{n_1} + \frac{1}{n_2} \right) } \]

\[ (\bar{x}_1 - \bar{x}_2) \pm z \sqrt{s_1^2 \left( \frac{1}{n_1} + \frac{s_2^2}{n_2} \right) } \]

\[ \bar{d} \pm t \frac{s_d}{\sqrt{n}} \]

\[ \bar{x} \pm z \frac{s}{\sqrt{n}} \]

\[ \bar{x} \pm t \frac{s}{\sqrt{n}} \]

24. A political advisor wishes to construct a 95% confidence interval for the percentage of all voters who favor a particular proposed law, to within 2 percentage points. From experience he thinks that the proportion is about 60%. The minimum size sample he should take, based on the initial estimate of 60%, is

(a) 47  (b) 2305  (c) 1164  (d) 231  (e) 1576

25. In a test of hypotheses of the form \( H_0 : \mu = 0 \) versus \( H_1 : \mu > 0 \) using \( \alpha = .01 \), when the sample size is 19 the population is normal, and \( \sigma \) is unknown the rejection region will be the interval

(a) \([2.326, \infty)\)  (b) \([2.576, \infty)\)  (c) \([2.552, \infty)\)  (d) \([2.878, \infty)\)

(e) \([2.539, \infty)\)

26. In a test of hypotheses \( H_0 : \mu = 1873 \) versus \( H_1 : \mu < 1873 \), the rejection region is the interval \((-\infty, -2.896)\], the value of the sample mean computed from a sample of size 9 is \( \bar{x} = 1792 \), and the value of the test statistic is \( t = -2.655 \). The correct decision and justification are

(a) Reject \( H_0 \) because 1792 < 1873.

(b) Reject \( H_0 \) because \(-2.655 < 0\).

(c) Reject \( H_0 \) because otherwise a Type I error is committed.

(d) Do not reject \( H_0 \) because the sample is small.

(e) Do not reject \( H_0 \) because \(-2.896 < -2.655\).
27. In a test of hypotheses of the form $H_0 : \mu = 28$ vs. $H_1 : \mu \neq 28$ a sample of size 250 produced the test statistic $z = -1.065$. The $p$-value (observed significance) of the test is about

(a) .1065  (b) .2846  (c) .6423  (d) .3577  (e) -.2846

28. A large sample is collected in order to study the relationship between two variables $x$ and $y$ to investigate whether $x$ can be used to predict $y$. It is found that $r = -.65$. The true statement is

(a) $x$ and $y$ are almost perfectly linearly correlated, and $y$ increases as $x$ is increased
(b) $x$ and $y$ are moderately linearly correlated, and $y$ increases as $x$ is increased
(c) $x$ and $y$ are almost perfectly linearly correlated, and $y$ decreases as $x$ is increased
(d) $x$ and $y$ are moderately linearly correlated, and $y$ decreases as $x$ is increased
(e) none of the statements above is correct

Problems 29 and 30 pertain to the following situation:

Surveys done several years ago showed that the population was evenly split on the question of cameras at intersections to photograph cars running red lights. In a recent poll of 1600 randomly selected people, 851 said that they oppose having cameras at intersections.

29. The setup of the null and alternative hypotheses to test whether there is sufficient evidence that a majority of people (i.e., more than 50%) now oppose having cameras at intersections is

(a) $H_0 : p = .52$ vs. $H_1 : p \neq .53$
(b) $H_0 : p = .50$ vs. $H_1 : p < .50$
(c) $H_0 : p = .50$ vs. $H_1 : p \neq .50$
(d) $H_0 : p = .50$ vs. $H_1 : p > .53$
(e) $H_0 : p = .50$ vs. $H_1 : p > .50$

30. The value of the test statistic is

(a) 2.550  (b) .0319  (c) 2.555  (d) .5319  (e) -2.555
Part II

1. Major League Baseball specifies that a game ball must have a coefficient of restitution (COR) of 55. To test whether baseballs currently in use have too large a COR, hence are “livelier” than they should be, 36 randomly selected baseballs were examined. The sample mean COR was 56.1, with a sample standard deviation of 2.9. The test is performed at the 1% level of significance.

(a) State the null and alternative hypotheses for the test. [2 points]

(b) State the correct formula for the test statistic. Justify your answer. [2 points]

(c) Construct the rejection region. [2 points]

(d) Compute the value of the test statistic, and make a decision. [4 points]

(e) State a conclusion about the mean COR of all baseballs, based on the test you performed. [2 points]

(f) Compute the \( p \)-value (or observed significance) of the test, and state what it means in the context of this problem. [2 points]
2. Researchers took CAT scans of the brains of healthy people and of people suffering a psychiatric disorder in order to compare the size of one portion of the brain between the two groups. The results were: healthy people: $n_1 = 10$, $\bar{x}_1 = 45$, $s_1 = 8$; ill people: $n_2 = 10$, $\bar{x}_2 = 34$, $s_2 = 8$.

Test whether the mean size of this portion of the brain in individuals with the disorder differs from that for healthy individuals, at the 5% level of significance, in the following series of steps. Assume that the populations of brain sizes are normally distributed, and have approximately equal standard deviations.

(a) State the null and alternative hypotheses for the test. [2 points]

(b) State the correct formula for the test statistic. Justify your answer. [2 points]

(c) Construct the rejection region. [2 points]

(d) Compute the value of the test statistic, and make a decision. [4 points]

(e) State a conclusion about the mean sizes of this portion of the brain, based on the test you performed. [2 points]
3. A pamphlet published by AAA gave the following information on vehicle speed (in miles per hour) and stopping distance (in feet):

<table>
<thead>
<tr>
<th>speed ($x$)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>distance ($y$)</td>
<td>0</td>
<td>20</td>
<td>50</td>
<td>95</td>
<td>150</td>
<td>230</td>
<td>300</td>
<td>400</td>
</tr>
</tbody>
</table>

$x = 35 \quad y = 155.625 \quad SS_{xx} = 4200 \quad SS_{xy} = 23975 \quad SS_{yy} = 143572 \quad SSE = 6715$

(a) Find the proportion of the variability in stopping distance that is accounted for by the vehicle’s speed. [4 points]

(b) Find the regression line for predicting $y$ from $x$. [4 points]

(c) If a car is going 45 miles per hour, what stopping distance is predicted by the regression equation found in part (b)? [2 points]

(d) Construct a 95% prediction interval for the stopping distance if a vehicle is going 45 miles per hour. [4 points]