Exam 3 · (100 pts.)
Stat 145 – Spring 2013

Name:______________________________________ Section:_____________

Selected z* values from Table C:

| C | 90% | 95% | 99% |
|---|---|---|---|
| z* | 1.645 | 1.960 | 2.576 |

**For credit show or explain all answers.**

1. Suppose, as is roughly true, the amount of money U.S. smokers spend on cigarettes each year is distributed normally with a mean ($\mu$) of $1,250 and a standard deviation ($\sigma$) of $220.

(a) (5 pts.) What is the probability that a single randomly selected smoker in the U.S, spends more than $1,350 each year on cigarettes?

(b) (5 pts.) What is the probability the average of 10 randomly selected smokers in the U.S. spends more than $1,350 each year on cigarettes?

2. A spinner can land on numbers 1, 2, or 3. Each of these outcomes is equally likely.

(a) (4 pts.) If the spinner is spun twice and the sum of the two spins is recorded, what is the sample space?

(b) (3 pts.) What is the probability the sum will be 4?

(c) (4 pts.) Let A be the event the first spin is 1. Let B be the event the second spin is even. Explain if events A and B are or are not disjoint.

3. A random sample of 49 four-year public colleges has a mean annual tuition of $5,900. Suppose annual tuition at four-year public colleges is distributed normally with a known standard deviation ($\sigma$ ) of $689. (Note: selected z* values from Table C are listed at the top of this exam.)

(a) (5 pts.) Construct a 99% confidence interval for the average tuition at four-year public colleges, rounded to the nearest dollar.

(b) (5 pts.) Interpret the interval in part (a) above (i.e. say in words what it means).

(c) (5 pts.) How many four-year public colleges must we sample if we want to estimate mean annual tuition at four-year public colleges within a margin of error of ± $210 with 99% confidence?

(d). (4 pt.) What would be the critical value (z*) if the confidence level was changed to 92%?

4. At a large hospital the average number of new hospital-acquired infections is 16.5 infections per week. Hospital staff decides to implement new procedures to reduce the number of hospital-acquired infections. Four months after the new procedures were implemented, an SRS of 9 weeks found an average of 15.3 infections per week. Suppose hospital-acquired infections are normally distributed with a known standard deviation ($\sigma$) of 2.1 infections per week. At the 5% level of significance, is there evidence the new procedures reduced the rate of hospital-acquired infections?

(a) (4 pts.) State your hypotheses using mathematical notation (symbols).

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

(c) (4 pts.) Determine the p-value.

(d) (4 pts.) State your conclusion in terms of the problem.

5. (4 pts.) Human blood is grouped into four types: O, A, B, and AB. The following table lists the probability of these blood types for a randomly selected American. The table has missing values for the probabilities of blood types A, B, and AB. A single person is to be drawn at random. The probability of drawing an American with blood type O or A is .85, and the probability of not drawing an American with blood type B is .88. Fill in the appropriate probabilities by the question marks in the following table. *Show your work below.*

| Political Affiliation | O | A | B | AB |
|---|---|---|---|---|
| Probability | .44 | ? | ? | ? |

**Multiple Choice (4 pts. each)**

6. A North American roulette wheel has 38 slots, of which 18 are red, 18 are black, and 2 are green. Suppose you decide to bet on red on each of 10 consecutive spins of the roulette wheel. Suppose you lose all 5 of the first wagers. Which of the following is true?
   A) You should get more spins of red on the next 5 spins of the wheel, since you didn't get any on the first 5 spins.
   B) The wheel is not working properly. It favors outcomes that are not red. Hence, during the next five spins of the wheel, you're likely to continue to see few red outcomes.
   C) What happened on the first 5 spins tells us nothing about what will happen on the next 5 spins.
   D) We're due for a win, so the sixth spin of the wheel is very likely to come up red.

7. A random variable can be described as
   A) a variable whose value is a numerical outcome of a random phenomenon.
   B) a probability of an event.
   C) the proportion of times an event occurs over a long run of repeated trials.
   D) All of the above

8. In formulating hypotheses for a statistical test of significance, the null hypothesis is often
   A) a statement that the data are all 0.
   B) the probability of observing the data you actually obtained.
   C) a statement of “no effect” or “no difference.”
   D) 0.05.

9. In a survey of sleeping habits, 8400 national adults were selected randomly and contacted by telephone. Respondents were asked: "Typically, how many times per week do you sleep less than 6 hours during the night?" On average, those surveyed reported an average of 1.8 nights per week in which they got less than 6 hours of sleep. Which of the following is true with respect to this scenario?

A) 8400 is the size of the population being studied.
B) 1.8 is a parameter and represents an estimate of the unknown value of a statistic of interest.
C) 1.8 is a statistic and represents an estimate of the unknown value of a parameter of interest.
D) None of the above

10. Suppose you're in a class of 35 students. The instructor takes a simple random sample of 7 students and observes their heights. Imagine all of the different samples possible. Let $\bar{X}$ denote the mean height in your sample. The distribution of all values taken by $\bar{X}$ in all possible samples of 7 students selected from the 35 students in your class is
A) the probability that $\bar{X}$ is obtained.
B) the parameter.
C) the standard deviation of values.
D) the sampling distribution of $\bar{X}$.

11. The number of column inches of classified advertisements appearing on Mondays in a certain daily newspaper has mean 320 inches and standard deviation 30 inches. Suppose that the results for 100 consecutive Mondays can be regarded as a random sample and let $\bar{X}$ denote the mean number of column inches of classified advertisements in the sample. Assuming a sample of 100 is sufficiently large, the random variable$\bar{X}$ has
A) a sampling distribution that has a mean of 320 inches.
B) a sampling distribution that is approximately Normal by the central limit theorem.
C) a sampling distribution that has a standard deviation of 3 inches.
D) All of the above

12. I collect a random sample of size *n* from a population and from the data collected compute a 95% confidence interval for the mean of the population. Which of the following would produce a new confidence interval with smaller width (smaller margin of error) based on these same data?
A) Use a smaller confidence level.
B) Use a larger confidence level.
C) Use the same confidence level, but compute the interval *n* times. Approximately 5% of these intervals will be larger.
D) Nothing can guarantee absolutely that you will get a smaller interval. One can only say the chance of obtaining a smaller interval is 0.05.

13. In a statistical test of hypotheses, we say the data are statistically significant at level $\alpha$ if

A) the *P*-value is less than $\alpha$.

B) the *P*-value is larger than $\alpha$.

C) $\alpha = 0.05$

D) $\alpha$ is small.

14. SHOW WORK: Suppose that the population of the scores of all high school seniors that took the SAT-M (SAT math) test this year follows a Normal distribution, with mean $\mu$ and standard deviation $\sigma = 100$. You read a report that says, "On the basis of a simple random sample of 100 high school seniors that took the SAT-M test this year, a confidence interval for $\mu$ is $512.00 \pm 25.76$." The confidence level for this interval is

A) over 99.9%.

B) 99%.

C) 95%.

D) 90%.

15. SHOW WORK: A manufacturing process produces bags of cookies. The distribution of content weights of these bags is Normal with mean 16.0 oz and standard deviation 0.8 oz. We will randomly select *n* bags of cookies and weigh the contents of each bag selected. How many bags should be selected so that the standard deviation of the sampling distribution is 0.1 ounces?

A) 100 bags

B) 64 bags

C) 10 bags

D) 8 bags