

# MAT 121 Statistics I

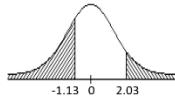
## Midterm Exam #2

10/25/2022

Time: 75 minutes

### Problem 1

Find the area of the indicated region under the standard normal curve

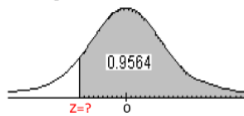


Answers \*

- ☐ 0.8489
- ☐ 0.1292
- ☒ 0.1504
- ☐ 0.0212
- ☐ 0.9788

### Problem 2

Find the z-score that corresponds to the given area under the standard normal curve.



Answers \*

- ☐ 1.71
- ☒ -1.71
- ☐ 1-0.9564
- ☐ -1.96
- ☐ -0.0436

### Problem 3

The role of the sample mean in a confidence interval estimate for the population mean is to:

Answers \*

☐

determine the amount by which the estimate will miss the true population mean.

☐

determine the margin of error in the estimate.

☐

establish the level of confidence for the estimate.

☒

determine the center of the confidence interval

☐

None of the listed answers is true

### Problem 4

The Central Limit Theorem predicts that

Answers \*

☐

The sampling distribution of  $\mu$  will be approximately normal for  $n > 30$

☒

the sampling distribution of  $\bar{x}$  will be approximately normal for  $n > 30$

☐

the sampling distribution of  $p$  will be approximately normal for  $n > 30$

☐

the sampling distribution of  $\pi$  will be approximately normal for  $n > 30$

### Problem 5

A study was conducted to determine what proportion of all college students considered themselves as full-time students. A random sample of 300 college students was selected and 210 of the students responded that they considered themselves full-time students. Which of the following would represent the target parameter of interest?

Answers \*

☐

mean

☒

Proportion

### Problem 6

In a sample of 155 students, it is found that 21 made an A. What is the margin of error of the 95% confidence interval of p constructed based on the sample information?

Answers \*

☐

$$E = 1.96 \times \frac{\sqrt{21(155-21)}}{155}$$

☐

$$E = 1.96 \times \frac{\sqrt{\frac{21}{155} \left( \frac{155-21}{155} \right)}}{155}$$

☒

$$E = 1.96 \times \frac{\sqrt{\frac{21}{155} \left( \frac{155-21}{155} \right)}}{\sqrt{155}}$$

☐

$$E = 1.96 \times \frac{\sqrt{\frac{21}{155} + \frac{155-21}{155}}}{\sqrt{155}}$$

☐

$$E = 0.95 \times \frac{\sqrt{\frac{21}{155} \left( \frac{155-21}{155} \right)}}{\sqrt{155}}$$

### Problem 7

The heights (in inches) of adult males in the United States are believed to be Normally distributed with mean  $\mu$ . The average height of a random sample of 25 American adult males is found to be  $\bar{x} = 69.72$  inches, and the standard deviation of the 25 heights is found to be  $s = 4.15$ . A 90% confidence interval for  $\mu$  is

Answers \*

☐

$$69.72 \pm (1.708) \times 4.15 / \sqrt{25}$$

☒

$$69.72 \pm (1.711) \times 4.15 / \sqrt{25}$$

☐

$$69.72 \pm (1.708) \times 4.15 / \sqrt{24}$$

☐

$$69.72 \pm (1.316) \times 4.15 / \sqrt{25}$$

### Problem 8

Which of the following is a property of the sampling distribution of sample proportion?

Answers \*

☐

An increase in the sample size  $n$  will result in an increase in the standard deviation of  $\hat{p}$ .

☐

The mean of  $\hat{p}$  is different from the population  $p$ .

☒

The sampling distribution will be approximately normally distributed when  $np$  and  $n(1-p)$  are both bigger than 5.

### Problem 9

Which of the following is a property of the sampling distribution of sample proportion?

Answers \*

☐

An increase in the sample size  $n$  will result in an increase in the standard deviation of  $\hat{p}$ .

☐

The mean of  $\hat{p}$  is different from the population  $p$ .

☒

The sampling distribution will be approximately normally distributed when  $np$  and  $n(1-p)$  are both bigger than 5.

### Problem 10

In developing a confidence interval for the population mean, the t-distribution is used to obtain the critical value when

Answers \*

☐

the sample contains some extreme values that skew the results.

☐

the population standard deviation is unknown.

☐

the sample is not a random sample.

☐

the confidence level is low

☒

the population is normal, the sample size is small, and the standard deviation is unknown.

### Problem 11

In developing a confidence interval for the population mean, the t-distribution is used to obtain the critical value when

Answers \*

☐

the sample contains some extreme values that skew the results.

☐

the population standard deviation is unknown.

☐

the sample is not a random sample.

☐

the confidence level is low

☒

the population is normal, the sample size is small, and the standard deviation is unknown.

### Problem 12

A sample of size  $n$  is taken from a population that is normally distributed with mean  $\mu$  and standard deviation  $\sigma$ . Which of the following statements about the sampling distribution of sample mean is true?

Answers \*

☐

Using the Central Limit Theorem,  $\bar{X}$  approximately follows  $\bar{X} \sim N(\mu, \sigma/\sqrt{n})$

☐

Using the Central Limit Theorem,  $\bar{X}$  exactly follows  $\bar{X} \sim N(\mu, \sigma/\sqrt{n})$

☐

Without using the Central Limit Theorem,  $\bar{X}$  approximately follows  $\bar{X} \sim N(\mu, \sigma/\sqrt{n})$

☒

Using the property of normal distribution,  $\bar{X}$  exactly follows  $\bar{X} \sim N(\mu, \sigma/\sqrt{n})$

☐

Only if the sample size is large,  $\bar{X}$  exactly follows  $\bar{X} \sim N(\mu, \sigma/\sqrt{n})$

### Problem 13

Explain what the phrase "95% confident" means when we interpret a 95% CI for  $\mu$

Answers \*

☐

95% of the observations in the population fall within the bounds of the calculated interval.

☒

In repeated sampling, 95% of constructed intervals would contain the value of  $\mu$ .

☐

The probability that the mean falls in the calculated interval is 0.95.

☐

95% of similarly constructed intervals would contain the value of the sampled mean.

☐

The confidence interval has a 95% chance to be correct.

### Problem 14

A simple random sample of 20 US adults is obtained and each person's red blood cell count (in cells per microliter) is measured. A sample mean is 4.63. Let  $\mu$  be a mean blood cell count for all US adults.

Suppose the population standard deviation is unknown, but a sample standard deviation is given. If you wanted to compute a 90% confidence interval for  $\mu$  and use a t-interval procedure, what is the appropriate t-value you need to use in computing of a margin of error in your confidence interval, give appropriate degrees of freedom?

Answers \*

☒

df=19, t=1.729

☐

df=20, t=1.725

☐

df=19, t=1.328

☐

df=20, t=1.325

### Problem 15

A random sample of 36 customers buying petrol was selected. From this sample, the 95% confidence interval estimate for the mean amount of petrol purchased per customer for the city was calculated to be between 14.5 and 20.5 gallons. Based on this information, the sample mean and the margin of error is given by

Answers \*



$$\bar{X} = (14.5 + 20.5)/2, \quad E = (20.5 - 14.5)/2$$



$$\bar{X} = (14.5 + 20.5)/2, \quad E = (20.5 - 14.5)$$



$$\bar{X} = (14.5 + 20.5)/2, \quad E \text{ cannot be determined}$$



$$\bar{X} \text{ cannot be determined, } E = (20.5 - 14.5)/2$$



Both  $\bar{X}$  and  $E$  cannot be determined.

### Problem 16

The effect of acid rain upon the yield of crops is of concern in many places. To determine baseline yields, a sample of 13 fields was selected, and the yields of barley ( $\text{g}/400 \text{ m}^2$ ) were obtained and the sample mean and standard deviation are given, respectively, by 220 and 60. Assume that yields of barley are normally distributed. A 95% confidence interval for the mean yield is

Answers \*



$$220 \pm 1.96(60/\sqrt{13})$$



$$220 \pm 1.96(60/\sqrt{12})$$



$$220 \pm 2.18(60/\sqrt{13})$$



$$220 \pm 2.16(60/\sqrt{13})$$



$$220 \pm 2.18(60/\sqrt{12})$$



### Problem 17

Which of the following statements about the relationship between confidence level and critical value is correct? [Hint: you can see the formula on the last page of the note used in week 07].

Answers \*

☐

The lower the confidence level, the larger the critical value (implying a wider confidence interval).

☐

The lower the confidence level, the smaller the critical value (implying a narrower confidence interval).

☒

The higher the confidence level, the larger the critical value (implying a wider confidence interval).

☐

The higher the confidence level, the smaller the critical value (implying a narrower confidence interval).

☐

The confidence level is independent of the critical value.

### Problem 18

A 95% confidence interval for the mean reading achievement score for a population of third-grade students is (44.2, 54.2). Suppose you compute a 99% confidence interval using the same information. Which of the following statements is correct?

Answers \*

☐

The intervals have the same width.

☐

The 99% interval is shorter.

☒

The 99% interval is longer.

☐

The standard deviation of the same mean becomes bigger

☐

The standard deviation of the same mean becomes smaller.

### Problem 19

A publishing company is studying the sales of various franchises in their chain of stores. They draw a random sample of 75 stores in the chain, and measure the average daily sales. They find that  $\bar{x} = \$5,670$  and  $s = \$1,750$ . Calculate a 90% confidence interval for  $\mu$ , the mean daily sales of their stores.

Answers \*

- ☐ (\$2791.3 , \$8548.8)
- ☒ (\$5337.6 , \$6002.4)
- ☐ (\$5149.5 , \$6190.5)
- ☐ (\$5410.9 , \$5929.1)
- ☐ (\$3920.0 , \$7420.0)

### Problem 20

A simple random sample of 30 US adults is obtained and each person's red blood cell count (in cells per microliter) is measured. A sample mean is 4.63. Let  $\mu$  be a mean blood cell count for all US adults.

Suppose a 95 % confidence interval is: (4.13, 5.13). Based on that interval do you think it is reasonable to assume that  $\mu$  is equal to 4 cells per microliter? Select appropriate answer from the following [Hint: think about the interpretation of CI]:

Answers \*

- ☒ No, because the lower endpoint of CI is above 4 cells per microliter
- ☐ Yes, because CI is above 4 cells per microliter
- ☐ Yes, because the sample mean was only slightly above 4 cells per microliter
- ☐ No, because the sample mean was above 4 cells per microliter
- ☐ Not enough information to answer the question.

### Problem 21

The rates of return on 7 natural resources mutual funds are given below:

14.75 15.01 16.95 18.07 14.81 15.59 17.86

The mean and standard deviation of the above sample are  $\bar{x} = 16.15, s = 1.45$ . Calculate a 99% confidence interval for  $\mu$ , the mean rate of return of natural resources mutual funds.

Answers \*

☐

(14.74 , 17.56)

☐

(14.23 , 18.07)

☐

(14.31 , 17.99)

☒

(14.12 , 18.18)

☐

(15.36 , 16.94)

### Problem 22

An insurance company checks records on 582 accidents selected at random and notes that teenagers were at the wheel in 91 of them. Construct a 95% confidence interval for the proportion of all auto accidents that involve teenage drivers.

Answers \*

☒

(12.7% , 18.6%)

☐

(10.3% , 17.2%)

☐

(10.6% , 18.2%)

☐

(11.7% , 19.5%)

### Problem 23

A random sample of  $n = 300$  measurements is drawn from a binomial population with probability of success  $\hat{p} = .43$ . Give the mean and the standard deviation of the sampling distribution of the sample proportion.

Answers \*

☐

.57; .029

☐

.43; .014

☐

.57; .014

☒

.43; .029

### Problem 24

A randomly selected sample of 400 students at a university with 15-week semesters was asked whether or not they think the semester should be shortened to 14 weeks (with longer classes). Forty-six percent (46%) of the 400 students surveyed answered "yes." Which one of the following statements about the number 46% is correct?

Answers \*

☒

It is a sample statistic.

☐

It is a population parameter.

☐

It is a margin of error.

☐

It is a standard error.

### Problem 25

In a random sample of 28 families, the average weekly food expense was \$95.60 with a standard deviation of \$22.50. Determine whether a normal distribution or a t -distribution should be used or whether neither of these can be used to construct a confidence interval. Assume the distribution of weekly food expenses is normally shaped.

Answers \*

☐

Cannot use normal distribution or t-distribution.

☐

Use normal distribution.

☒

Use the t-distribution.

## Midterm Exam #2 Summary

### 1. Five Number Summary :

The five-number summary is used to describe the shape of the distribution of a given numerical data. It consists of five numbers: minimum data value, first quartile, median, the third quartile, and the maximum data value.

The five-number summary of this given data set is:

stats	value
Min.	40.00
1st Qu.	70.00
Median	76.00
3rd Qu.	84.00
Max.	100.00

### 2. Boxplot :

The boxplot is a geometric representation of the five-number summary. The boxplot of the given data set is given below.

