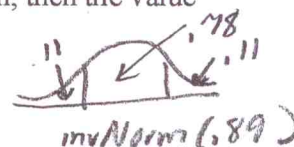


**I. Multiple Choice, True/False, Short Answer.** (Multiple choice questions are 2 points each, others as indicated – 36 points total)

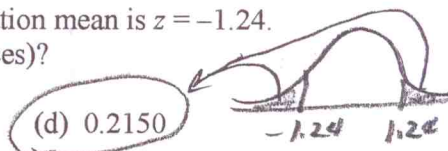
1. If we want to compute a 78% confidence interval for a population mean, then the value of  $z^*$  (rounded to three decimal places) will be:

- (a) 0.772    (b) 1.227    (c) 1.534    (d) None of the above



2. The test statistic for a two-sided significance test for a population mean is  $z = -1.24$ . What is the corresponding  $p$ -value (rounded to four decimal places)?

- (a) 0.1075    (b) 0.8925    (c) 0.7850



3. Write “true” or “false” next to each statement according to which is correct. (2 points each – 8 points total)

False The population mean is always contained in a  $z$  or  $t$  confidence interval for a population mean.

False Keeping the sample size fixed, the margin of error for a  $z$ -confidence interval for a population mean  $\mu$  will increase if the confidence level is decreased.

True At the same level of confidence, the margin of error for a  $z$ -confidence interval for a population mean  $\mu$  will decrease if the sample size is increased.

True If the hypothesis test:  $H_0: \mu = \mu_0$  versus  $H_a: \mu \neq \mu_0$  for a population mean  $\mu$  is significant at the  $\alpha = 0.05$  level, then the corresponding 95% confidence interval for  $\mu$  will not contain  $\mu_0$ .

4. Each of 60 randomly chosen subjects is asked to guess an integer from 1 to 10. Let  $X$  be the number of subjects that guess the integer 5. Assuming the subjects are guessing randomly then  $X$  has a binomial distribution (yes, I am telling you this!) with parameters  $n = \underline{60}$  and  $p = \underline{1/10}$ . (2 points each – 4 total)

or .10

5. Subjects in a weight loss experiment are put on a special diet. The subjects are weighed at the beginning of the diet and weighed six weeks later at the end of the diet. Which of the following tests of significance will you use to determine if the diet was successful?

(a) The two sample  $t$ -test.

(b) The paired  $t$ -test.

(c) The  $z$ -test for a single population mean.  
proportion.

(d) The  $z$ -test for a population

**I. Multiple Choice, True/False, Short Answer, continued.**

6. Suppose that 27% of Americans classify themselves as Republicans. If a random sample of 400 Americans is chosen, let  $X$  be the number in the sample who classify themselves as Republicans and  $\hat{p}$  be the proportion in the sample who classify themselves as Republicans. Please answer the following:

(a) On average, about how many Americans in the sample do you expect to classify themselves as Republicans? (3 points)

$$400(.27) = 108$$

(b) Which of the following is true about the sampling distribution of  $\hat{p}$ ?

(1) It is approximately normal with mean 108.

(2) It is binomial with mean 108.

(3) It is approximately normal with mean 0.27.

(4) It is approximately normal with mean 27.

7. A recent Associate Press-AOL News poll reported that 43% of Americans trust Democrats to do a better job of protecting the country. This result was based on a sample of 2000 Americans with a margin of error of 2.2% with 95% confidence. What is the corresponding confidence interval for the true proportion of Americans that trust Democrats to do a better job of protecting the country? (3 points)

$$\begin{array}{l} .43 - .022 \\ .43 + .022 \end{array} \Rightarrow (.408, .452)$$

8. The  $P$ -value for a hypothesis test is 0.041. At which of the following significance levels is the data statistically significant? There may be more than one correct answer, circle all that are correct.

(a)  $\alpha = 0.10$

(b)  $\alpha = 0.05$

(c)  $\alpha = 0.025$

(d)  $\alpha = 0.01$

9. Give the definition of the  $P$ -value for a hypothesis test (4 points):

The likelihood of getting a result as extreme as the data in the direction of the alternative hypothesis assuming the null hypothesis is true.

10. A recent CNN/Opinion Research Corporation Poll reported that 69% of Americans would not like to see the Supreme Court reverse its Roe versus Wade decision concerning abortion. Sandra, a Longwood student, believes that the true percent of college students in Virginia who would not like to see this happen is significantly higher than this. Let  $p$  be the true proportion of college students in Virginia who would not like to see the Supreme Court reverse its Roe versus Wade decision concerning abortion. What hypotheses should Sandra use to test her belief? Clearly indicate which hypothesis is Sandra's belief. (4 points)

$$H_0: p = .69$$


$$H_a: p > .69 \leftarrow \text{Sandra's Belief}$$

**Problem II.** What is the smallest sample size you would need to estimate the proportion of Americans that approve of the job George Bush is doing as President of the United States with a margin of error of no more than 5% with 92% confidence? Please show all work for this computation. (10 points)

$$n = \left( \frac{z^*}{2m} \right)^2 = \left( \frac{1.75}{2(0.05)} \right)^2 = 306.25$$

307

$z^* = 1.75$



$\text{invNorm}(0.96) = 1.75$

**Problem III.** In a recent USA Today/Gallup Poll conducted on March 23-25, 2007 to assess the favorability ratings of certain public officials, 191 of the 1007 randomly chosen Americans said they had “never heard of” Speaker of the House Nancy Pelosi. Please answer the following. (17 points total)

(a) Using the polling data above, give a point estimate for the true proportion,  $p$ , of Americans who have “never heard of” Speaker of the House Nancy Pelosi. (4 points)

$$\hat{p} = \frac{191}{1007} = .1897$$

Symbol	Param. or Stat.?	Value (if known)
$X$	Stat	191
$n$	XXXXXX	1007
$\hat{p}$	Stat	.1897
$p$	Param	unknown

(b) Complete the table above (note that  $X$  is the count in the sample that have “never heard of” Speaker of the House Nancy Pelosi.). For each symbol indicate if it is a parameter or statistic and give its value if known. If the value is unknown, indicate so in the table. (7 points)

(c) Find a 90% confidence interval for the true proportion of Americans who have “never heard of” Speaker of the House Nancy Pelosi. Write a complete English sentence giving the meaning of this confidence interval in the context of this problem. (6 points)

Stat 1-Prop Z Int: (.16935, .20999). We are 90% confident the true percent (proportion) of Americans who have never heard of Speaker of the House Nancy Pelosi is between 16.9% (.169) and 21% (.21).

**Problem IV.** Let  $\mu_1$  be the average yearly income of students who major in computer science five years after graduating from college and let  $\mu_2$  be the average yearly income of students who major in business five years after graduating from college. A test of the hypotheses  $H_0: \mu_1 = \mu_2$  versus  $H_a: \mu_1 > \mu_2$  resulted in a  $P$ -value of 0.23. What conclusion can we reach about the average yearly income of these two groups? Be sure to state your conclusion in the context of this problem. (10 points)

Since the  $p$ -value is large we fail to reject the null hypothesis. Thus the average yearly income of CS majors five years after college is not significantly greater than that of the business majors.

**Problem V.** A local barber shop wants to improve its efficiency. Let  $\mu$  be the average length of time (in minutes) for a haircut at the barber shop. An efficiency expert randomly times 20 haircuts during the course of a week. Below are the data and a histogram of the data. Please answer the following questions. (27 points total)

(a) What is a point estimate for  $\mu$ , the true average length of time for *all* haircuts at the barber shop? (5 points)

$$\bar{x} = 20.3$$

(b) Suppose we want to test the hypotheses  $H_0: \mu = 24$  versus  $H_a: \mu < 24$ . Which test will you use to test

these hypotheses (i.e. the z-test, t-test, 1 proportion z-test, etc.) and why? You should clearly state how you know the appropriate assumptions are satisfied in order to use the test. (5 points)

Since  $n > 15$  and via the histogram above we see that the data is unimodal and not strongly skewed, we will use the t-test for a population mean.

(c) What are the test statistic and P-value of the hypothesis test in part (b)? (6 points)

Test Statistic =  $-3.28$       P-value =  $.00198$

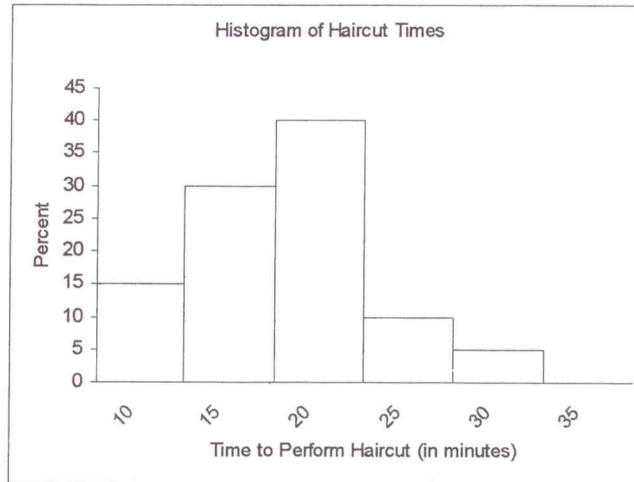
(d) Draw a picture that shows the test statistic and P-value computed in part (c). (5 points)



data =  $-3.28$       t curve w/ 19 d.o.f

(e) What is your conclusion of the test in the context of the problem? (6 points)

Since the p-value is small ( $< .01$ ) we reject the null hypothesis in favor of the alternative. Thus the average length of time for a haircut at this barber shop is significantly less than 24 minutes.



Time to Perform Haircut (minutes)
22
19
20
20
14
17
24
21
23
18
15
26
22
19
22
14
26
12
18
34