

AP STATISTICS - CHAPTER 9 MC

NAME: _____

9.1 + 9.2 MC

Multiple choice: Select the best answer for Exercises 27 to 30.

27 Experiments on learning in animals sometimes measure how long it takes mice to find their way through a maze. The mean time is 18 seconds for one particular maze. A researcher thinks that a loud noise will cause the mice to complete the maze faster. She measures how long each of 10 mice takes with a noise as stimulus. The sample mean is $\bar{x} = 16.5$ seconds. The appropriate hypotheses for the significance test are

- (a) $H_0: \mu = 18; H_a: \mu \neq 18$.
- (b) $H_0: \mu = 16.5; H_a: \mu < 18$.
- (c) $H_0: \mu < 18; H_a: \mu = 18$.
- (d) $H_0: \mu = 18; H_a: \mu < 18$.
- (e) $H_0: \bar{x} = 18; H_a: \bar{x} < 18$

28 You use technology to carry out a significance test and get a P-value of 0.031. The correct conclusion is

- (a) accept H_a at the $\alpha = 0.05$ significance level.
- (b) reject H_0 at the $\alpha = 0.05$ significance level.
- (c) reject H_0 at the $\alpha = 0.01$ significance level.
- (d) fail to reject H_0 at the $\alpha = 0.05$ significance level.
- (e) fail to reject H_a at the $\alpha = 0.05$ significance level.

P-value = .031 < $\alpha = .05$ Reject H_0

29 Vigorous exercise helps people live several years longer (on average). Whether mild activities like slow walking extend life is not clear. Suppose that the added life expectancy from regular slow walking is just 2 months. A statistical test is more likely to find a significant increase in mean life expectancy if

- (a) it is based on a very large random sample and a 5% significance level is used.
- (b) it is based on a very large random sample and a 1% significance level is used.
- (c) it is based on a very small random sample and a 5% significance level is used.
- (d) it is based on a very small random sample and a 1% significance level is used.
- (e) the size of the sample doesn't have any effect on the significance of the test

Power of a test
select the largest possible sample size and α

30. A researcher plans to conduct a significance test at the $\alpha = 0.01$ significance level. She designs her study to have a power of 0.90 at a particular alternative value of the parameter of interest. The probability that the researcher will commit a Type II error for the particular alternative value of the parameter at which she computed the power

- is (a) 0.01 (b) 0.10 (c) .89 (d) .90 (e) .99

$P(\text{Type I}) = \alpha$
 $P(\text{Type II}) = \beta$
 $\text{Power} = 1 - \beta$
 $\text{Power} = .90 \rightarrow \beta = .1$

57. After once again losing a football game to the archrival, a college's alumni association conducted a survey to see if alumni were in favor of firing the coach. An SRS of 100 alumni from the population of all living alumni was taken, and 64 of the alumni in the sample were in favor of firing the coach. Suppose you wish to see if a majority of living alumni are in favor of firing the coach. The appropriate test statistic is

$\hat{p} = 64/100$
 $p_0 = .5$

- (a) $z = \frac{0.64 - 0.5}{\sqrt{\frac{0.64(0.36)}{100}}}$ (d) $z = \frac{0.64 - 0.5}{\sqrt{\frac{0.64(0.36)}{64}}}$
 (b) $t = \frac{0.64 - 0.5}{\sqrt{\frac{0.64(0.36)}{100}}}$ (e) $z = \frac{0.5 - 0.64}{\sqrt{\frac{0.5(0.5)}{100}}}$
 (c) $z = \frac{0.64 - 0.5}{\sqrt{\frac{0.5(0.5)}{100}}}$

To H SE based on H_0

59. The z statistic for a test of $H_0: p = 0.4$ versus $H_a: p > 0.4$ is $z = 2.43$. This test is
- (a) not significant at either $\alpha = 0.05$ or $\alpha = 0.01$.
 - (b) significant at $\alpha = 0.05$ but not at $\alpha = 0.01$.
 - (c) significant at $\alpha = 0.01$ but not at $\alpha = 0.05$.
 - (d) significant at both $\alpha = 0.05$ and $\alpha = 0.01$.
 - (e) inconclusive because we don't know the value of \hat{p} .

$P(Z > 2.43) = .0075$
 Normalcdf(2.43, 999, 0, 1)

58. Which of the following is not a condition for performing a significance test about an unknown population proportion p ?

- (a) The data should come from a random sample or randomized experiment. \checkmark
- (b) Individual measurements should be independent of one another. \checkmark
- (c) The population distribution should be approximately Normal, unless the sample size is large. \checkmark
- (d) Both np and $n(1 - p)$ should be at least 10. \checkmark (normal condition)
- (e) If you are sampling without replacement from a finite population, then you should sample no more than 10% of the population. \checkmark

60. Which of the following 95% confidence intervals would lead us to reject $H_0: p = 0.30$ in favor of $H_a: p \neq 0.30$ at the 5% significance level?
- (a) (0.29, 0.38)
 - (b) (0.19, 0.27)
 - (c) (0.27, 0.31)
 - (d) (0.24, 0.30)
 - (e) None of these

Reject H_0 means $p_0 = .30$ is NOT in the interval

AP STATISTICS

NAME: _____

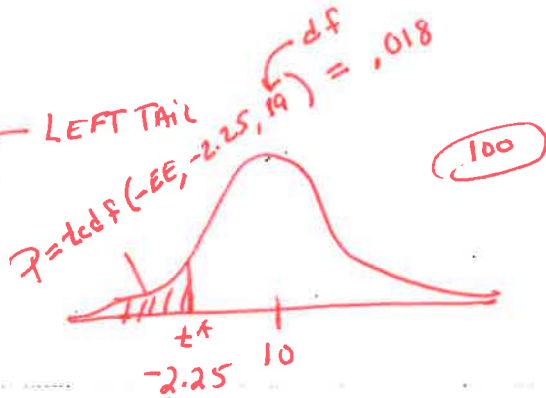
9.3

Section Tests about a Population Mean

Multiple choice: Select the best answer for Exercises 99 to 104. (10 POINTS EACH)

99. The reason we use t procedures instead of z procedures when carrying out a test about a population mean is that
- (a) z can be used only for large samples.
 - (b) z requires that you know the population standard deviation σ .
 - (c) z requires you to regard your data as an SRS from the population.
 - (d) z applies only if the population distribution is perfectly Normal.
 - (e) z can be used only for confidence intervals.

100. You are testing $H_0: \mu = 10$ against $H_a: \mu < 10$ based on an SRS of 20 observations from a Normal population. The t statistic is $t = -2.25$. The P -value
- (a) falls between 0.01 and 0.02. ✓
 - (b) falls between 0.02 and 0.04.
 - (c) falls between 0.04 and 0.05.
 - (d) falls between 0.05 and 0.25.
 - (e) is greater than 0.25.



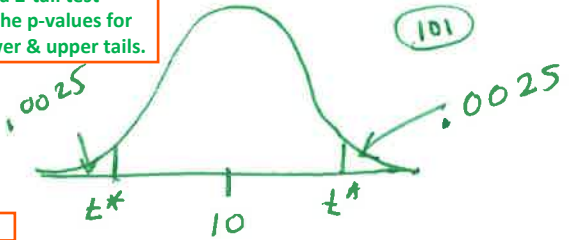
101. You are testing $H_0: \mu = 10$ against $H_a: \mu \neq 10$ based on an SRS of 15 observations from a Normal population. What values of the t statistic are statistically significant at the $\alpha = 0.005$ level?

Notice this is a 2-tail test so you need the p-values for BOTH the lower & upper tails.

Only the p-values for ONE of the tails.

- (a) ~~$t > 3.326$~~
- (b) ~~$t > 3.286$~~
- (c) ~~$t < -3.286$ or $t > 3.286$~~
- (d) $t < -3.326$ or $t > 3.326$ ✓
- (e) ~~$t > 2.977$~~

$P\text{-value} = .0025 * 2$
 $.005 \geq .005$
 $\text{tcdf}(3.326, e99, 14)$



$P\text{-value} = \text{tcdf}(3.286, e99, 14) = .0027 * 2 = .0054 > .005$

Statistically significant when our P -value is less than the chosen significance level (α), the result is statistically significant.

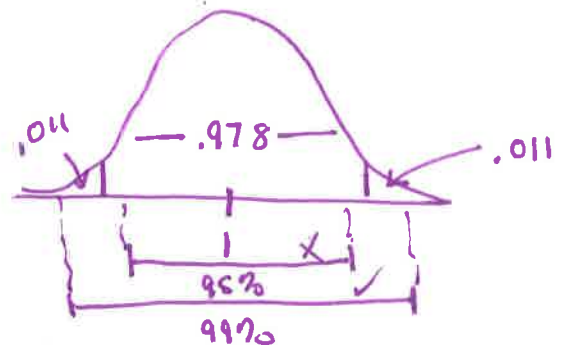
102. After checking that conditions are met, you perform a significance test of $H_0: \mu = 1$ versus $H_a: \mu \neq 1$. You obtain a P -value of 0.022. Which of the following is true?

2TAIL

- (a) A 95% confidence interval for μ will include the value 1.
- (b) A 95% confidence interval for μ will include the value 0.
- (c) A 99% confidence interval for μ will include the value 1. ✓
- (d) A 99% confidence interval for μ will include the value 0.
- (e) None of these is necessarily true.

$P\text{-value} = .022 / 2 = .011$

2TAIL HT \approx CI

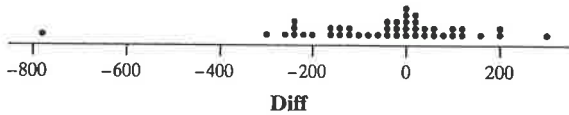


OVER

103. Does Friday the 13th have an effect on people's behavior? Researchers collected data on the numbers of shoppers at a sample of 45 different grocery stores on Friday the 6th and Friday the 13th in the same month. The dotplot and computer output below summarize the data on the difference in the number of shoppers at each store on these two days (subtracting in the order 6th minus 13th).³²

INDEPENDENT - Different Fridays

Shoppers not randomly selected



N	Mean	Median	TrMean	StDev	SEMean	Min	Max	Q1	Q3
45	-46.5	-11.0	-37.4	178.0	26.1	-774.0	302.0	-141.0	53.5

Normal

Researchers would like to carry out a test of $H_0: \mu_d = 0$ versus $H_a: \mu_d \neq 0$, where μ_d is the true mean difference in the number of grocery shoppers on these two days. Which of the following conditions for performing a paired t test is *not* met?

- I. Random II. Normal III. Independent
- (a) I only (c) III only (e) I, II, and III
- (b) II only (d) I and II only

104. The most important condition for sound conclusions from statistical inference is that

- (a) the data come from a well-designed random sample or randomized experiment.
- (b) the population distribution be exactly Normal.
- (c) the data contain no outliers.
- (d) the sample size be no more than 10% of the population size.
- (e) the sample size be at least 30.

Chapter 9 AP Statistics

Section I: Multiple Choice *Select the best answer for each question.*
(8 POINTS EACH)

Never accept

T9.1. An opinion poll asks a random sample of adults whether they favor banning ownership of handguns by private citizens. A commentator believes that more than half of all adults favor such a ban. The null and alternative hypotheses you would use to test this claim are

- (a) $H_0: \hat{p} = 0.5; H_a: \hat{p} > 0.5$
- (b) $H_0: p = 0.5; H_a: p > 0.5$
- (c) $H_0: p = 0.5; H_a: p < 0.5$
- (d) $H_0: p = 0.5; H_a: p \neq 0.5$
- (e) $H_0: p > 0.5; H_a: p = 0.5$

T9.2. You are thinking of conducting a one-sample t test about a population mean μ using a 0.05 significance level. You suspect that the distribution of the population is not Normal and may be moderately skewed. Which of the following statements is correct?

- (a) You should not carry out the test because the population does not have a Normal distribution.
- (b) You can safely carry out the test if your sample size is large and there are no outliers. *CLT*
- (c) You can safely carry out the test if there are no outliers, regardless of the sample size.
- (d) You can carry out the test only if the population standard deviation is known.
- (e) The t procedures are robust—you can use them any time you want.

T9.3. To determine the reliability of experts who interpret lie detector tests in criminal investigations, a random sample of 280 such cases was studied. The results were

Examiner's Decision	Suspect's True Status	
	Innocent	Guilty
"Innocent"	131	15
"Guilty"	9	125

140 N=280

If the hypotheses are H_0 : suspect is innocent versus H_a : suspect is guilty, then we could estimate the probability that experts who interpret lie detector tests will make a Type II error as *Conditional Probability*

- (a) 15/280.
- (b) 9/280.
- (c) 15/140.
- (d) 9/140.
- (e) 15/146.

P(Type 2) = P(fail to reject H_0 given H_0 is false) = 15/140

T9.4. A significance test allows you to reject a null hypothesis H_0 in favor of an alternative H_a at the 5% significance level. What can you say about significance at the 1% level?

- (a) H_0 can be rejected at the 1% significance level. *Not given p-value*
- (b) There is insufficient evidence to reject H_0 at the 1% significance level.

- (c) There is sufficient evidence to accept H_0 at the 1% significance level.
- (d) H_a can be rejected at the 1% significance level.
- (e) The answer can't be determined from the information given.

T9.5. A random sample of 100 likely voters in a small city produced 59 voters in favor of Candidate A. The observed value of the test statistic for testing the null hypothesis $H_0: p = 0.5$ versus the alternative hypothesis $H_a: p > 0.5$ is

- (a) $z = \frac{0.59 - 0.5}{\sqrt{\frac{0.59(0.41)}{100}}}$
- (b) $z = \frac{0.59 - 0.5}{\sqrt{\frac{0.5(0.5)}{100}}}$ *10H based on Ho*
- (c) $z = \frac{0.5 - 0.59}{\sqrt{\frac{0.59(0.41)}{100}}}$
- (d) $z = \frac{0.5 - 0.59}{\sqrt{\frac{0.5(0.5)}{100}}}$
- (e) $t = \frac{0.59 - 0.5}{\sqrt{\frac{0.5(0.5)}{100}}}$

T9.6. A researcher claims to have found a drug that causes people to grow taller. The coach of the basketball team at Brandon University has expressed interest but demands evidence. Over 1000 Brandon students volunteer to participate in an experiment to test this new drug. Fifty of the volunteers are randomly selected, their heights are measured, and they are given the drug. Two weeks later, their heights are measured again. The power of the test to detect an average increase in height of one inch could be increased by *when $\alpha \uparrow$ and/or $n \uparrow$*

- (a) using only volunteers from the basketball team in the experiment.
- (b) using $\alpha = 0.01$ instead of $\alpha = 0.05$.
- (c) using $\alpha = 0.05$ instead of $\alpha = 0.01$.
- (d) giving the drug to 25 randomly selected students instead of 50.
- (e) using a two-sided test instead of a one-sided test.

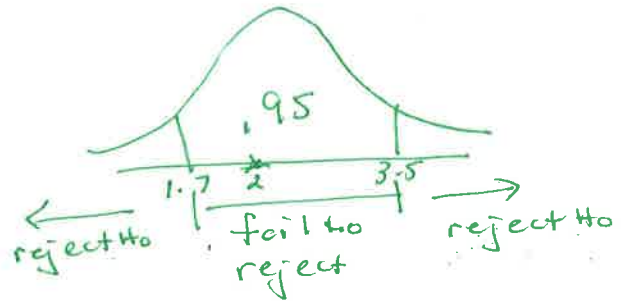
Memorize table →

Tip: Type II Error - is when you fail "not" reject H_0 when you really should have.

	H_0 true	H_0 false
Reject H_0	α I	Power
Fail to Reject H_0	correct	β II

H_0 is in CI therefore fail to reject

T9.7. A 95% confidence interval for a population mean μ is calculated to be (1.7, 3.5). Assume that the conditions for performing inference are met. What conclusion can we draw for a test of $H_0: \mu = 2$ versus $H_a: \mu \neq 2$ at the $\alpha = 0.05$ level based on the confidence interval?



- (a) None. We cannot carry out the test without the original data.
- (b) None. We cannot draw a conclusion at the $\alpha = 0.05$ level since this test is connected to the 97.5% confidence interval.
- (c) None. Confidence intervals and significance tests are unrelated procedures.
- (d) We would reject H_0 at level $\alpha = 0.05$.

(e) We would fail to reject H_0 at level $\alpha = 0.05$.

T9.8. In a test of $H_0: p = 0.4$ against $H_a: p \neq 0.4$, a random sample of size 100 yields a test statistic of $z = 1.28$. The P-value of the test is approximately equal to

- (a) 0.90.
- (b) 0.40.
- (c) 0.05.
- (d) 0.20.
- (e) 0.10.

$P\text{value} = P(Z > 1.28) * 2 = .100 * 2 = .200$
 normalcdf(1.28, 999, 0, 1)

T9.9. An SRS of 100 postal employees found that the average time these employees had worked at the postal service was 7 years with standard deviation 2 years. Do these data provide convincing evidence that the mean time of employment μ for the population of postal employees has changed from the value of 7.5 that was true 20 years ago? To determine this, we test the hypotheses $H_0: \mu = 7.5$ versus $H_a: \mu \neq 7.5$ using a one-sample t test. What conclusion should we draw at the 5% significance level?

CALCULATOR

[STAT] [TESTS] 2) T-Test
 Stats

$\mu_0 = 7.5$ $\bar{x} = 7$ $s_x = 2$ $n = 100$

$\mu: \neq \rightarrow t = -2.5$
 $P = .014 < \alpha = .05$
 Reject H_0

- (a) There is convincing evidence that the mean time working with the postal service has changed.
- (b) There is not convincing evidence that the mean time working with the postal service has changed.
- (c) There is convincing evidence that the mean time working with the postal service is still 7.5 years.
- (d) There is convincing evidence that the mean time working with the postal service is now 7 years.
- (e) We cannot draw a conclusion at the 5% significance level. The sample size is too small.

T9.10. Are TV commercials louder than their surrounding programs? To find out, researchers collected data on 50 randomly selected commercials in a given week. With the television's volume at a fixed setting, they measured the maximum loudness of each commercial and the maximum loudness in the first 30 seconds of regular programming that followed. Assuming conditions for inference are met, the most appropriate method for answering the question of interest is

- (a) a one-proportion z test.
- (b) a one-proportion z interval.
- (c) a paired t test.
- (d) a paired t interval.
- (e) None of these.

(c) a paired t test. because you will look at the differences