AP Statistics 9.1A Activity
Writing Hypotheses

Name Key
Per ____ Date ____

b 1. In their advertisements, a new diet program would like to claim that their methods result in a mean weight loss of more than ten pounds in two weeks. In order to determine if this is a valid claim, they hire an independent testing agency that then selects twenty-five people to be placed on this diet. The agency should be testing the null hypothesis H_0: $\mu = 10$ and the alternative hypothesis

(a) $H_a : \mu < 10$
(b) $H_a : \mu > 10$
(c) $H_a : \mu \leq 10$
(d) $H_a : \mu \geq 10$
(e) $H_a : \mu \neq 10$

e 2. To determine if having children within the first two years of marriage increases the divorce rate, where p = proportion of marriages that end in divorce, we should test the hypotheses

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

c 3. The average growth of a certain variety of pine tree is 10.1 inches in three years. A biologist claims that a new variety will have a greater three-year growth. A random sample of 25 of the new variety has an average three-year growth of 10.8 inches and a standard deviation of 2.1 inches. The appropriate null and alternative hypotheses to test the biologist's claim are

(a) H_0: $\mu = 10.8$, H_a: $\mu > 10.8$
(b) H_0: $\mu = 10.8$, H_a: $\mu \neq 10.8$
(c) H_0: $\mu = 10.1$, H_a: $\mu > 10.1$
(d) H_0: $\mu = 10.1$, H_a: $\mu < 10.1$
(e) H_0: $\mu = 10.1$, H_a: $\mu \neq 10.1$

don't use sample data!

b 4. The mean area μ of the several thousand apartments in a new development is advertised to be 1250 square feet. A tenant group thinks that the apartments are smaller than advertised. They hire an engineer to measure a sample of apartments to test their suspicion. The appropriate null and alternative hypotheses, H_0 and H_a, for this test are

(a) H_0: $\mu = 1250$ and H_a: $\mu \neq 1250$.
(b) H_0: $\mu = 1250$ and H_a: $\mu < 1250$.
(c) H_0: $\mu = 1250$ and H_a: $\mu > 1250$.
(d) H_0: $\mu \leq 1250$ and H_a: $\mu = 1250$.
(e) cannot be specified without knowing the size of the sample used by the engineer.

a 5. One effect of the pesticide DDT upon birds is to inhibit the production of the enzyme carbonic anhydrase, which controls calcium metabolism. It is believed that this causes eggshells to be thinner and weaker than normal and makes the eggs more prone to breakage. An experiment was conducted where 16 sparrow hawks were fed a mixture of 3 ppm dieldrin and 15 ppm DDT (a combination often found in contaminated prey). The first egg laid by each bird was measured, and the mean shell thickness was found to be 0.19 mm. A "normal" eggshell has a mean thickness of 0.2 mm. The null and alternative hypotheses are

(a) H_0: $\mu = 0.2$, H_a: $\mu < 0.2$
(b) H_0: $\mu \geq 0.2$, H_a: $\mu = 0.2$
(c) H_0: $\bar{x} = 0.2$, H_a: $\bar{x} < 0.2$
(d) H_0: $\bar{x} = 0.19$, H_a: $\bar{x} = 0.2$
(e) H_0: $\mu = 0.2$, H_a: $\mu \neq 0.2$

a 6. The P-value of a test of a null hypothesis is the probability that
(a) assuming the null hypothesis is true, the test statistic will take a value at least as extreme as that actually observed. ✓
(b) assuming the null hypothesis is ~~false~~, the test statistic will take a value at least as extreme as that actually observed. ✗
(c) the null hypothesis is true. ✗
(d) the null hypothesis is false. ✗
(e) the alternative hypothesis is true. ✗

C 7. In testing hypotheses, which of the following would be strong evidence against the null hypothesis?
(a) Using a small level of significance
(b) Using a large level of significance
(c) Obtaining data with a small P-value
(d) Obtaining data with a large P-value
(e) Obtaining data with a low test statistic

Small P
$P < \alpha$
↓
significance level

C 8. In a statistical test of hypotheses, we say the data are statistically significant at level α if
(a) $\alpha = 0.05$.
(b) α is small.
(c) the P-value is less than α.
(d) the P-value is larger than α.
(e) the sample statistics resulting from the data is more than two standard errors away from the mean.

C 9. A university administrator obtains a sample of the academic records of past and present scholarship athletes at the university. The administrator reports that no significant difference was found in the mean GPA (grade point average) for male and female scholarship athletes (P = 0.287). This means that
(a) the GPAs for male and female scholarship athletes are identical, except for 28.7% of the athletes.
(b) the maximum difference in GPAs between male and female scholarship athletes is 0.287.
(c) the chance of obtaining a difference in GPAs between male and female scholarship athletes as large as that observed in the sample, if there is no difference in mean GPAs, is 0.287.
(d) the chance that a pair of randomly chosen male and female scholarship athletes would have a significant difference in GPAs is 0.287.
(e) the probability that female athletes have higher GPAs than males do is 0.287.

If H_0 is true (no diff in GPA) the probability we got this result is .287 by chance

d 10. A test of significance produces a P-value of 0.024. Which of the following conclusions is appropriate?
(a) ~~Accept H_a~~ at the $\alpha = 0.05$ level
(b) Reject ~~H_a~~ at the $\alpha = 0.01$ level
(c) Fail to reject H_0 at the $\alpha = .05$ level
(d) Reject H_0 at the $\alpha = 0.05$ level
(e) ~~Accept H_0~~ at the $\alpha = 0.01$ level

Never accept!

$0.024 \not< 0.01$ Fail to reject H_0
$0.024 < 0.05$ Reject H_0

d 11. If a significance test gives P-value 0.005, very low
(a) the null hypothesis is very likely to be true. ✗
(b) we do not have convincing evidence in favor of the null hypothesis. ✗
(c) we do not have convincing evidence against the null hypothesis. ✗
(d) we do have convincing evidence against the null hypothesis. ✓
(e) we have convincing evidence in favor of the alternative hypothesis.

d 12. 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 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: $\mu \leq 18$; H_a: $\mu = 18$.
(d) H_0: $\mu = 18$; H_a: $\mu < 18$.
(e) H_0: $\bar{x} = 18$; H_a: $\bar{x} < 18$.

never use sample data in hypotheses

b 13. 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.

$0.031 < 0.05$ Reject H_0
$0.031 \not< 0.01$

14. For the following settings, define the parameter of interest and write the appropriate null and alternative hypotheses for the test that is described: *According to the Humane Society, 33% of households in the United States own at least one cat. You are interested in determining whether the proportion of households of the students at your school that own at least one cat is different from the national proportion.*

$H_0: p = 0.33$
$H_a: p \neq 0.33$

p = proportion of US households that own at least one cat

15.

(a) For the following settings, define the parameter of interest and write the appropriate null and alternative hypotheses for the test that is described: *The mean weight of loaves of bread produced at the bakery where you work is supposed to be one pound. You are the supervisor of quality control at the bakery, and you are concerned that new personnel are producing loaves that have a mean weight of more than one pound.*

$H_0: \mu = 1$
$H_a: \mu > 1$

μ = mean weight of loaves of bread at the bakery (in pounds)

Suppose you weigh an SRS of bread loaves and find that the mean weight is 1.025 pounds, which yields a *P*-value of 0.086.

(b) Interpret the *P*-value in the context of the problem.

If the actual mean weight for the loaves of bread is 1 lb., the probability of getting a mean weight of 1.025lbs is 0.086 (or .86%)

(c) What conclusion would you draw at the $\alpha = 0.05$ level? At the $\alpha = 0.10$ level?

$0.086 \not< 0.05$ Fail to Reject H_0
We do not have convincing evidence that the mean weight of the loaves of bread is greater than 1 lb.
$0.086 < 0.10$ Reject H_0
We do have convincing evidence that the mean weight