Review 9 AP Statistics Name:

1. For each of the following settings, define the parameter of interest and write the appropriate null and alternative hypotheses for the test that is described.

(a) 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.

(b) 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.

2. Consider the bakery problem in question 1(a). 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.

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

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

3. A contract between a manufacturer and a consumer of light bulbs specifies that the mean lifetime of the bulbs must be at least 1000 hours. As part of the quality assurance program, the manufacturer will institute an inspection program for each day's production of 10,000 units. An ordinary testing procedure is difficult since 1000 hours is over 41 days! Since the lifetime of a bulb decreases as the voltage applied increases, a common procedure is to perform an accelerated lifetime test in which the bulbs are lit using 400 volts (compared to the usual 110 volts). At such a voltage, a 1000-hour bulb is expected to last only 3 hours. This is a well-known procedure, and both sides have agreed that the results from the accelerated test will be a valid indicator of lifetime of the bulb.

The manufacturer will test the hypotheses $H_0: \mu = 3$ *versus* $H_a: \mu < 3$ at the $\alpha = 0.01$ level with an SRS of 100 bulbs.

(a) Describe what a Type I error would be in this context.

(b) What is the probability of making a Type I error when performing this test?

(c) Describe what a Type II error would be in this context.

(d) Which error—Type I or Type II—is likely to do more damage to the manufacturer's relationship with the consumer? Explain.

4. Eleven percent of the products produced by an industrial process over the past several months have failed to conform to specifications. The company modifies the process in an attempt to reduce the rate of nonconformities. In a random sample of 300 items from a trial run, the modified process produces16 nonconforming items.

(a) Do these results provide convincing evidence that the modification is effective? Support your conclusion with a test of significance.

(b) Explain what the *P*-value of your test means in the context of this problem.

5. The germination rate of seeds is defined as the proportion of seeds that, when properly planted and watered, sprout and grow. A certain variety of grass seed usually has a germination rate of 0.80, and a company wants to see if spraying the seeds with a chemical that is known to change germination rates in other species will change the germination rate of this grass species.

(a) Suppose the company plans to spray a random sample of 400 seeds and conduct a two-sided test of $H_0 : p = 0.8$, using $\alpha = 0.05$. They determine that the power of this test against the alternative $p = 0.75$ is 0.69. Explain what this means in the context of the problem.

(b) Describe two ways the company can increase the power of the test.

(c) The company researchers spray 400 seeds with the chemical, and 307 of the seeds germinate. This produces a 95% confidence interval for the proportion of seeds that germinate of (0.726, 0.809). Use this confidence interval to determine whether this test would reject or fail to reject the null hypothesis. Explain your reasoning.

6. The Environmental Protection Agency has determined that safe drinking water should contain no more than 1.3 mg/liter of copper. You are testing water from a new source, and take 30 water samples. The mean copper content in your samples is 1.36 mg/l and the standard deviation is 0.18 mg/l. There do not appear to be any outliers in your data.

(a) Do these samples provide convincing evidence at the $\alpha = 0.05$ level that the water from this source contains unsafe levels of copper? Justify your answer.

(b) How would your conclusion change if your sample mean had been 1.355 mg/l? What point does this make about statistical significance?

7. A consumer advocacy group tests the mean vitamin C content of 50 different brands of bottled juices using, in each case, a *t*-test of significance in which the null hypothesis is the mean amount of vitamin C that is on the nutrition facts label for that brand of juice. They find that two of the 50 juice brands have statistically significantly lower Vitamin C than claimed at the $\alpha = 0.05$ level. Is this an important discovery? Explain.

8. Tai Chi is often recommended as a way to improve balance and flexibility in the elderly. Below are before-and-after flexibility ratings (on a 1 to 10 scale, 10 being most flexible) for 8 men in their 80's who took Tai Chi lessons for six months.

Subject	A	B	C	D	E	F	G	H
Flexibility rating after Tai Chi	2	4	3	3	3	4	5	10
Flexibility rating before Tai Chi	1	2	1	2	1	4	2	6

Do these paired data adequately meet the Normality condition for a *t*-procedure? Justify your answer.

9. A pharmaceutical company is testing a new drug for reducing cholesterol levels. To approve the drug for the next round of testing, they need to show that this drug reduces mean total cholesterol level by at least 50 mg/dL. They initially plan a study that involves 50 subjects and a significance level of $\alpha = 0.05$, but they discover that the power of the test against this effect size is only 0.24. What are two ways they can increase the power of the test without changing effect size?