

## AP Statistics Chapter 11 Practice Free Response Test

1. It is believed that the average amount of money spent per U.S. household per week on food is about \$98, with standard deviation \$10. A random sample of 100 households in a certain affluent community yields a mean weekly food budget of \$100. We want to test the hypothesis that the mean weekly food budget for all households in this community is higher than the national average.

Perform a significance test at the 5% significance level. Follow the Inference Toolbox.

2. Read the brief newspaper article on using a depression pill to help smokers quit.

### Depression Pill Seems to Help Smokers Quit

BOSTON — Taking an antidepressant medicine appears to double smokers' chances of kicking the habit, a study found. The Food and Drug Administration approved the marketing of this medicine, called Zyban or bupropion, to help smokers in May. The results of several studies with the drug, including one published in today's issue of the *New England Journal of Medicine*, were made public then.

The newly published study was conducted on 615 volunteers who wanted to give up smoking and were not outwardly depressed. They took either Zyban or dummy pills for 6 weeks. A year later, 23 percent of those getting Zyban were still off cigarettes, compared with 12 percent in the comparison group.

- (a) The results of this experiment were significant at the  $\alpha = 0.05$  significance level. In your opinion, are the results practically significant? Justify your position.
  - (b) To what population can the results of this study be generalized? Explain.
  - (c) Can we conclude that taking Zyban causes people to quit smoking? Justify your answer.
3. When the manufacturing process is working properly, NeverReady batteries have lifetimes that follow a right-skewed distribution with  $\mu = 7$  hours and  $\sigma = 0.5$  hours. A quality control supervisor selects a simple random sample of  $n$  batteries every hour and measures the lifetime of each. If she is convinced that the mean lifetime of all batteries produced that hour is less than 7 hours at the 1% significance level, then all those batteries are discarded.
    - (a) State appropriate hypotheses for the quality control supervisor to test.
    - (b) Describe a Type I and a Type II error in this situation.
    - (c) Describe the consequences of each of the above errors.

## AP Statistics Chapter 11 Practice Free Response Test – SOLUTIONS

### 1. Complete Significance Test

Step 1 – Hypotheses:  $H_0: \mu = \$98$  vs.  $H_a: \mu > \$98$

Step 2 – Conditions: SRS? Used a random sample  $\checkmark$

Normal? Sample size is  $100 > 30$ , so normal OK  $\checkmark$

Independent? Number of households is easily greater than 1000  $\checkmark$

Step 3 – Calculations:  $z = \frac{100 - 98}{10 / \sqrt{100}} = 2$ , so  $p = 0.0228$

Step 4 – Conclusion: Because the p-value is less than 0.05, there is sufficient evidence to reject the  $H_0$ . We can conclude that the mean weekly food budget for all households in this community is greater than the national average of \$98.

### 2. Use and Abuse of Significance Tests

- Although there was significant evidence that the proportion of those taking Zyban who successfully quit smoking was higher than the proportion of those taking a placebo, and although approximately twice as many taking Zyban quit as compared with those taking the placebo, it is also true that more than three-quarters of those taking the new drug were not successful in quitting smoking. That's a 77% failure rate. Accordingly, the argument can be made that the results are not practically important.
- Because the study used volunteers who wanted to give up smoking and who were not outwardly depressed, no generalization can be made to a population. Ideally, a randomly selected sample should be used.
- Despite being volunteers, as long as the subjects were randomly assigned to the treatment or the placebo group a cause and effect conclusion can be made.

### 3. Type I and Type II errors

(a)  $H_0: \mu = 7$  hours vs.  $H_a: \mu < 7$  hours

(b) A Type I error would occur if the supervisor decided that the mean lifetime of the batteries was less than 7 hours and discarded all the batteries when the process is actually working properly.

A Type II error would occur if the supervisor decided that the process was working fine, when in fact the mean battery lifetime was less than 7 hours.

(c) Type I – You throw out a lot of good batteries – loss of money.

Type II – You send out bad batteries, giving company a bad name.