**Chapter 13: Statistical Testing of Differences and Relationships**

**Multiple Choice**

1. Suppose in our sample results we find that males average drinking five soft drinks per week, compared with six soft drinks per week for females. In the absence of additional analysis, what type of difference has been illustrated?

a. statistical difference

b. managerially important difference

c. a difference of dispersion

d. mathematical difference

e. none of these

Answer: d

1. What is the purpose of statistical inferences?

a. to fully describe the characteristics of the population

b. to make generalizations about population characteristics from sample results

c. to estimate mean, median, mode, variance, and skewness of large sample data

d. to study characteristics of binomial or Poisson random variables

e. all of these

Answer: b

1. In a beer consumption study, a researcher makes an assumption that males will consume more beer per week than females; this can be stated in a:

a. research objective.

b. given level of significance.

c. hypothesis.

d. theory.

e. rule.

Answer: c

1. What is the purpose of hypothesis testing?

a. to draw conclusive decisions about sample estimates

b. to determine whether there is support to draw conclusions about some characteristics of the population given the evidence provided by the sample results

c. to summarize and describe the sample data

d. to test whether the sample is scientifically drawn from a target population

e. to conduct statistical tests on census data

Answer: b

1. Which of the following is *not* a step in hypothesis testing?

a. evaluating the randomness of the sample

b. stating null and alternative hypotheses

c. choosing the appropriate statistical test

d. developing a decision rule given the significance level

e. All of these are steps in hypothesis testing.

Answer: a

1. The hypothesis of the status quo is typically referred to as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ hypothesis.

a. type III

b. alternative

c. statistical

d. null

e. valid

Answer: d

1. When do you say the difference between two numbers is statistically significant?

a. as long as the two numbers are not exactly the same

b. if the difference is large enough so that it is managerially important

c. if the difference is mathematically different

d. if the difference is observed over an extended period of time

e. if the difference is large enough to be unlikely to have occurred because of chance or sampling error

Answer: e

1. Which of the following is the appropriate statistical test when examining cross tabulations?

a. chi-square test

b. t-test

c. z-test

d. one-way ANOVA

e. none of these

Answer: a

1. In testing a hypothesis about means, if the sample size was less than 30, then the appropriate statistical test would be?

a. chi-square test

b. t-test

c. z-test

d. one-way ANOVA

e. cross-tabulation

Answer: b

1. In most statistical software packages, the t-test is often substituted for which test statistic?

a. chi-square test

b. f-test

c. z-test

d. one-way ANOVA

e. cross-tabulation

Answer: c

1. The exact probability of getting a computed test statistic that was largely due to chance is referred to as the\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

a. p-value

b. chi-square value

c. z-test value

d. median value

e. t-test value

Answer: a

1. For comparing means, most statistical software packages use which test?

a. chi-square

b. anova

c. t-test

d. beta

e. sums of squares

Answer: c

1. What is the meaning of testing a hypothesis at an alpha level of 0.05?

a. There is 95% confidence that the observed results are due to sampling error or because of sample randomness.

b. The chances of not rejecting the null hypothesis when it is false is more than 5%.

c. There is a 95% chance that the observed result from the sample analysis will also occur in the population.

d. The probability of committing a Type II error is about 5%.

e. There is 95% chance of a gamma error.

Answer: c

1. What kind of error is being made if the researcher fails to reject the null hypothesis when it is, in fact, false?

a. chi-square

b. type I

c. type II

d. type III

e. none of these

Answer: c

1. Why is it the null hypothesis called the hypothesis of the status quo?

a. It is the hypothesis that will not be rejected, unless the data provide convincing evidence that it is false, thus maintaining the status quo.

b. It is not the research claim being tested.

c. It is the hypothesis that recommends the method of analysis.

d. The alternative hypothesis is operational only in the event of a Type II error.

e. all of these

Answer: a

1. Which of the following is the first step in hypothesis testing?

a. calculating the value of the test statistic

b. stating the hypothesis

c. choosing the appropriate test statistic

d. stating the conclusion

e. developing a decision rule

Answer: b

1. A researcher is interested in comparing product rating scores between males and females. By drawing a sample of males and a sample of females, the researcher needs to find a statistical test that applies to\_\_\_\_\_\_\_\_\_\_\_\_.

a. independent samples

b. dependent samples

c. convenience samples

d. paired samples

e. none of these

Answer: a

1. Samples in which the measurement of a variable in one population may influence the measurement of the variable in the other are called:

a. stratified samples.

b. dependent samples.

c. related samples.

d. constrained samples.

e. nonprobability samples.

Answer: c

1. What type of data would be necessary to have when testing for differences in means?

a. nominal

b. ordinal

c. metric

d. none of these

Answer: c

1. A market researcher is trying to determine whether males differ from females with regard to the following question: Do you drink soft drinks? Which of the following tests would be most appropriate?

a. chi-square test

b. 1-way AVOVA test

c. correlation analysis

d. median test

e. Kolmogorov-Smirnov Test

Answer: a

1. Hypotheses about frequency distributions that involve one or more nominally scaled variables can be tested using \_\_\_\_\_\_\_\_\_\_\_\_.

a. chi-square test

b. t-test

c. f-test

d. z-test

e. ANOVA test

Answer: a

1. What determines the decision of whether to use a one-tailed test or a two-tailed test when testing hypotheses to make inferences about a population mean?

a. the sample size and the estimated standard error

b. the nature of the situation and what the researcher is trying to demonstrate

c. the level of significance of the test

d. the sample size relative to the population size

e. the standard error relative to the sample variance

Answer: b

1. The number of observations minus the number of assumptions necessary to calculate a statistic equals:

a. the Z score.

b. ANOVA.

c. random variation.

d. degrees of freedom.

e. the power of the test.

Answer: d

1. Researchers must be careful to distinguish statistical significance from:

a. mathematical significance.

b. chance significance.

c. practical significance.

d. random significance.

Answer: c

1. Hypotheses are stated in two basic forms: \_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_.

a. null and fake

b. null and real

c. null and alternative

d. alternative and real

Answer: c

1. A(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a standard used to determine whether to reject or fail to reject the null hypothesis.

a. decision rule

b. common rule

c. determined rule

d. assessment rule

Answer: a

1. A(n) \_\_\_\_ test is a test of the probability that a particular calculated value could have been due to chance.

a. Q

b. Z

c. T

d. F

Answer: d

1. A test to determine whether the difference between proportions is greater than would be expected because of sampling error is which of the following?

a. hypothesis test of proportions

b. t-test

c. z-test

d. chi-square test

e. none of these

Answer: a

1. Type II error is most closely related to which of the following?

a. beta

b. alpha

c. omega

d. all of these

e. none of these

Answer: a

1. This particular test involves evaluating the differences in observed and expected frequencies in a crosstab matrix.

a. hypothesis test of proportions

b. t-test

c. z-test

d. chi-square test

e. none of these

Answer: d

1. A researcher is attempting to determine which ethnic group is more likely to go to the movies at a movie theatre. The dependent variable is metric. Which of the following tests is most appropriate?

a. analysis of variance

b. t-test

c. z-test

d. chi-square test

e. none of these

Answer: a

1. Data that is metric is a combination of when two types?

a. Interval or nominal

b. Ratio or ordinal

c. Interval or ordinal

d. Ratio or nominal

e. Interval or ratio

Answer: e

**True/False**

1. In marketing research, the basic motive for making statistical inferences is to generalize from sample results to population characteristics.

Answer: True

1. An assumption or theory that a researcher or manager makes about some characteristic of the population under study is an inference.

Answer: False

1. The last step in testing a hypothesis is the development of a decision rule.

Answer: False

1. In testing a hypothesis from a random sample involving three or more means, the appropriate test would be a one-way ANOVA.
2. When testing hypotheses about frequency distributions, nominal variables are acceptable.

Answer: True

1. In related samples, the measurement of the variable of interest has no influence on the measurement of the variable in another sample.

Answer: False

1. The z-test would be appropriate for testing three or more proportions when the sample size is less than 30.

Answer: False

1. Mathematical differences are the same as statistically significant differences.

Answer: False

1. If a particular difference is large enough to be unlikely to have occurred because of chance or sampling error, then the difference is statistically significant.
2. A Type I error involves rejecting the null hypothesis when it is, in fact, true.

Answer: True

1. The chi-square test enables the research analyst to determine whether an observed pattern of frequencies corresponds to, or fits, an “unexpected pattern.”

Answer: False

1. The smaller the p value, the smaller is the probability that the observed result occurred by chance.

Answer: True

1. A p value of .285 would be acceptable for a research analyst to reject the null hypothesis.

Answer: False

1. ANOVA is used to analyze the differences of more than two means.

Answer: True

1. If the alternative hypothesis is supported, the researcher concludes there are significant differences in the phenomenon being measured.

Answer: True

1. There are fewer statistics available for analyzing nominal data than there are for analyzing metric data.

Answer: True

1. Researchers cannot perform statistical testing on nominal data.

Answer: False

1. Researchers cannot perform statistical testing unless the sample size is at least 30.

Answer: False

1. Failing to reject the null hypothesis is the same as accepting the null hypothesis.

Answer: False

1. Researchers very rarely know the population mean.

Answer: True

1. The issue of whether certain measurements are different from one another is central to many questions of critical interest to marketing managers.

Answer: True

1. In the decision that the null hypothesis is accepted, there must be enough evidence in the data that the alternative hypothesis is correct.

Answer: False

1. The chi-square test is a test to determine whether the difference between two proportions is greater than would be expected because of sampling error.

Answer: True

1. ANOVA is a statistical technique that permits the researcher to determine whether the variability among or across the independent sample means is greater than expected because of sampling error.

Answer: True

1. Big data does not mean “good” data.

Answer: True

1. Placing total reliance on significance testing is a good idea.

Answer: False

1. We usually meet all the assumptions underlying statistical testing.

Answer: False

1. In order to use the *t* test, the sample size must be at least 30.

Answer: False

**Essay Questions**

1. A consultant has a random sample of 400 usable responses in a database. Included are the following questions:

Household Income Category:  
(1) $0 to $24,999 (2) $25,000 to $49,999 (3) $50,000 to $99,999  
(4) $100,000 and over

Average Weekly Soft Drink Consumption: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The consultant wants to determine if there are any statistically significant differences in average weekly soft drink consumption by income category. What statistical test should be applied to give the consultant the information he needs?

Answer: Since the problem will involve comparing more than two means (ratio scale data) for statistically significant differences, 1-Way ANOVA should be used.

1. A consultant has collected 700 usable responses via a probability sample concerning political opinions. After analyzing each respondent’s political ideology, he/she divides the respondents into two groups, moderate liberals and moderate conservatives. Further, the consultant asks respondents the following:

How likely are you to vote for increasing property taxes in the next election?  
(1) very unlikely (2) somewhat unlikely (3) undecided  
(4) somewhat likely (5) very likely

The consultant wants to determine if the moderate conservatives differ significantly from moderate liberals concerning how they’ll vote on the property tax issue in the next election. How should the data be analyzed?

Answer: The problem involves comparing just two means, and the variable concerning property tax is metric (interval scale), the appropriate method of analysis would be a t-test.

1. Suppose a client wants to evaluate average weekly miles jogging by males and females. Initially, the consultant thinks a t-test would be the preferred method of analysis. However, the client wants to know where the differences exist among short, medium and long mileage joggers. What will the consultant have to do to satisfy his/her client?

Answer: The research would have to take the metric data concerning mileage and create 3 classes according to distance, low mileage, medium mileage and high mileage joggers. This could be done by observing a frequency distribution of the mileage responses and breaking it into 3 parts at approximately 0-33.3%, 33.4-66.7% and over 66.7%. Now mileage jogged weakly is in 3 discrete categories and can be cross tabulated with gender.

1. Illustrate a situation when is it more appropriate to use an Anova test rather than a cross tabulation with the chi-square test.

Answer: Generally, cross tabulation analysis is not appropriate when one of the variables contains continuous ratio data, which can take on numerous values. Hence, cross tabulation analysis and the associated chi-square test is limited to variables that can take on a very limited number of values. The ANOVA test works when one of the variables is discrete groups, such as income or educational attainment categories, analyzed in conjunction with a metric variable, which can be interval or ratio scale.

1. Distinguish between a Type I error and Type II error. What is the relationship between the two?

Answer: Type I error, or alpha level, is the probability that the researcher will reject the null hypothesis when it is actually true. Type II error, or beta error, is the probability that the researcher will fail to reject the null hypothesis when it should have been rejected. Type I error plus Type II error does not equal 1 unless the Type I error is 0. That is not a realistic case. The alpha level is set by the researcher, within the constraints of the project. Beta error is not determined by the researcher.

1. Explain the notions of mathematical differences, managerially important differences, and statistical significance.

Answer: Mathematical differences occur when two measures are not exactly the same. This does not mean that the difference is necessarily statistically significant nor managerially important. Statistical significance is a difference that is large enough to be unlikely to have occurred because of chance. Managerial importance is the concept that the difference is large enough to have meaning in the decision the manager makes.