

Chapter Outlines for:

Frey, L., Botan, C., & Kreps, G. (1999). *Investigating communication: An introduction to research methods*. (2nd ed.) Boston: Allyn & Bacon.

Chapter 13: Analyzing Differences Between Groups

I. Introduction

- A. While we don't always celebrate differences, we certainly seem fascinated by them.
- B. There are many important differences in types of data that can be analyzed; in each case, we would want to ask whether the difference is statistically significant; that is, whether the difference occurs by chance so rarely that the results are probably due to the real difference that exists.
- C. In this chapter, we focus on statistical procedures used in communication research to analyze such differences.

II. Types of Difference Analysis

- A. Difference analysis examines differences between the categories of an independent variable that has been measured using discrete categories as on a nominal scale.
1. For example, difference analysis is used to see whether there are differences between or among groups of people or types of texts.
 2. In each case, the independent variable is measured using a nominal scale and the research question or hypothesis is about the differences between the nominal categories with respect to some other variable; the dependent variable may be measured using a nominal, ordinal, interval, or ratio scale.
 - a. The particular type of procedure used to determine whether the differences between the categories of the nominal independent variable are statistically significant depend on how the dependent variable is measured (see Figure 13.1).
- B. The Nature of Nominal Data
1. The **Chi-square (X^2) test** examines differences between the categories of an independent variable with respect to a dependent variable measured on a nominal scale; there are two types of chi-square tests.
 - a. A **one-variable chi-square test** (also known as a **one-way/single-sample chi-square test**): assesses the statistical significance of differences in the distribution of the categories of a single nominal independent or dependent variable.
 - i. This statistical test begins by noting the frequencies of occurrence for each category, called the **observed frequencies**; researchers then calculate the **expected frequencies** (also called the **theoretical frequencies**) for each category (see Figure 13.2).
 - ii. When both the observed and expected frequencies have been noted, the chi-square calculated value is found by subtracting the expected frequency for each category/cell from the observed frequency, squaring this figure, and dividing by the expected frequency; the resulting figures for each category/cell are then added together to obtain the calculated value.
 - iii. The degrees of freedom are equal to the number of categories minus one.
 - b. A two-variable chi-square test (also called contingency table analysis, cross tabulation, multiple-sample chi-square test, two-way chi-square test) examines differences in the distributions of the categories created from two or more nominal independent variables or a nominal independent and dependent variable.
 2. It can be used to compare differences among the categories created from two nominal independent variables with regard to a nominal dependent variable, or to compare differences among the categories of a nominal independent variable with regard to the categories of a nominal dependent variable.
 - a. Researchers are interested in assessing differences among the distributions of the categories of two nominal variables of interest (see Figure 13.3).
 - b. The two-variable chi-square test is also used to assess differences between the categories of one nominal independent variable that constitute different groups of people and the categories of a nominal dependent variable.
- C. The Nature of Ordinal Data
1. Ordinal measurements not only categorize variables but also rank them along a dimension.
 2. Most analyses of data acquired from groups measured on an ordinal dependent variable use relationship analysis to see whether two sets of ordinal measurements are related to one another.
 3. Sometimes researchers examine whether there are significant differences between two groups of people with respect to how they rank a particular variable.
 - a. The **median test** (see Figure 13.4) is a statistical procedure used to analyze these data; the raw scores for all respondents are listed together, and the median is then calculated.

- i. The total number of scores in each of the two groups that fall above and below the median are determined and these are placed in a table that has the two groups as rows and the ratings above the grand median and below the grand median as the columns.
 - b. The **Mann-Whitney U-test** is used to analyze differences between two groups especially when the data are badly skewed.
 - c. The **Kruskal-Wallis test** is used to analyze differences between three or more groups.
 - d. The **Wilcoxon signed-rank test** is employed in the case of related scores, and can be used to examine differences between the rank scores.
- D. The Nature of Interval/Ratio Data
1. When the dependent variable is measured on an interval or ratio scale, the statistical procedures assess differences between group means and variances.
 2. A significant difference tends to exist when there is both a large difference between the groups and comparatively little variation among the research participants within each group.
 3. There are two types of difference analysis employed to assess differences between groups with respect to an interval/ratio dependent variable.
 4. t Test: used by researchers to examine differences between two groups measured on an interval/ratio dependent variable. Only two groups can be studied at a single time. Two types:
 - a. Independent-Sample t test: examines differences between two independent (different) groups; may be natural ones or ones created by researchers (Figure 13.5).
 - b. Related-Measures t Test (matched-sample or paired t test): examines differences between two sets of related measurements; most frequently used to examine whether there is a difference in two measurements.
 5. Analysis of Variance (ANOVA or *F* test): used when three or more groups or related measurements are compared (avoids additive error)
 - a. One-variable analysis of variance (one-way analysis of variance): examines differences between two or more groups on a dependent interval/ratio variable.
 - b. Repeated-measures of analysis of variance: examines whether there are differences between the measurement time periods.
 - c. Formula for one-variable ANOVA says that an *F* value is a ratio of the variance among groups (MS_b), also called systematic variance, to the variance within groups (MS_w), also called random variance.
 - d. ANOVA tells researchers if the difference among the groups is sufficiently greater than the differences within the groups to warrant a claim of a statistically significant difference among the groups.
 - e. ANOVA is an omnibus test, an overall statistical test that tells researchers whether there is any significant difference(s) that exist among the groups of related measurements.
 - f. Researchers use a multiple comparison test as a follow-up procedure to pinpoint the significant difference(s) that exists:
 - i. Scheffe Test
 - ii. Tukey Test
 - iii. Least Significant Difference
 - iv. Bonferroni technique
 - g. Factorial analysis of variance: used when researchers examine differences between the conditions created by two or more nominal independence variables with regard to a single interval/ratio dependent variable; all factorial ANOVAs yield two types of *F* values.
 - i. Main effects: refers to the overall effects of each independent variable.
 - ii. Interaction effects: refers to the unique combination of the independent variables.

- iii. When there are two independent variables, a factorial analysis of variance yields three F values; when there are three independent variables, a factorial analysis yields seven F values.
- iv. It is possible that a factorial ANOVA may reveal a significant main effect but no significant interaction effect (the reverse is also possible).
- v. Ordinal interaction: an interaction that, when plotted on a graph, the lines representing the two variables do not intersect.
- vi. Disordinal interaction: an interaction in which the lines cross.

III. Advanced Difference Analysis

- A. There exist many additional and more complex significance tests for analyzing differences between groups.
 - 1. Multivariate analysis: statistical procedures, which examine three or more independent variables and/or two or more dependent variables at the same time.
 - 2. Figure 13.7 explains the purpose of some of these advanced difference analyses and illustrates how each has been used to study communication behavior.

IV. Conclusion

- A. To know whether groups of people or texts are significantly different, researchers use the statistical procedures discussed in this chapter. All of these procedures result in a numerical value(s) that indicates how often the observed difference is likely to occur by chance or error.
- B. A finding that is very unlikely to occur by chance is assumed to be due to the actual difference that exists.