STUDY GUIDE

The Chicago Guide to Writing about Multivariate Analysis

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CONTENTS

Preface

This study guide was designed to provide practice applying the principles and tools introduced in *The Chicago Guide to Writing about Multivariate Analysis,* with a problem set and a series of suggested course extensions for each chapter.

The problem sets reinforce the concepts and skills from each chapter, usually working with data or written examples provided as part of the question. Some require calculations, others involve creating or critiquing tables, charts, or sentences. They can be used as homework assignments for courses on regression analysis, research methods, or research writing, or independently by readers who are trained in regression methods. Solutions for the odd-numbered problems can be downloaded separately.

The suggested course extensions apply the skills and concepts from *Writing about Multivariate Analysis* to the actual writing process. They involve reviewing existing work, applying statistics, writing, and revising—using either your own work in progress or published materials (books, articles, reports, or Web pages) in your field or that of your intended audience.

The "applying statistics" questions require access to a computerized database that includes several nominal, ordinal, and interval or ratio variables for at least several hundred cases. Ideally these variables should be related to a research question involving application of multivariate regression that you can use for the exercises throughout the study guide, yielding a comprehensive analysis for a complete research paper. These exercises also require access to the accompanying documentation describing the study design, data collection, coding, use of sampling weights, and related methodological issues for the data set from which your variables are taken. If you do not have a data set and documentation that fits these criteria, you can often find them on CD-ROMS that accompany research methods or statistics textbooks, or you can download them from sites such as the Inter-University Consortium for Political and Social Research (ICPSR).

Many of the suggested exercises for writing or revision entail peer-editing. They are most effective if done with one or more other people, whether as part of a course in which class time is devoted to these exercises, or working with a colleague. These exercises often involve writing or revising work to meet the instructions for authors for a leading journal in your field. Identify one or two such journals before you begin these tasks, allowing you to generate a coherent finished product for submission to that journal.

1 Introduction

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. Find a journal article from your field that involves an application of multivariate analysis. Identify the audience for that journal in terms of
   a. their discipline(s);
   b. their expected level of familiarity with the type of multivariate model used in the article. E.g., is that method widely used in the field, new to the field or topic but well-established elsewhere, or new to all fields?
   c. their expected use of the results (e.g., research, policy, education).

2. In that article:
   a. Circle one numeric fact or comparison each in the introduction, results section, and concluding section. For each:
      i. Identify its purpose. Does the author explicitly or implicitly convey the purpose, or is it left unclear?
      ii. Evaluate the ease of understanding that fact or comparison. Does the author convey its meaning and interpretation?
   b. Are there other places in the article where a number or comparison would be helpful? Identify the purpose of the number for each such situation.
   c. What tools are used to present numbers? Do they suit the objective and audience for the article?

3. Find an article in the popular press that refers to an application of a multivariate analysis. (The science and health sections of newspapers and magazines are good resources.)
   a. Who is the audience for the article (e.g., what is their expected reading level and amount of statistical training)?
   b. What is the objective of the article?
   c. Is the article written with appropriate vocabulary and examples for that audience?
   d. What tools are used to present numbers in the article? Do they suit the objective and audience?

2

Seven Basic Principles

PROBLEM SET

1. Use complete sentences to describe the relative sizes of the cities shown in table 2A.

Table 2A. Population of three largest cities worldwide, 1995

City	Population (millions)
Sao Paulo	16.5
Mexico City	16.6
Tokyo	27.0

Source: Population Reference Bureau, "World Population: More than Just Numbers" (Washington, DC: Population Reference Bureau, 1999).

2. One of the W's is missing from each of the following descriptions of table 2B. Rewrite each sentence to include that information.

Table 2B. Final medal standings of the top four countries, 2002 Winter Olympic Games

Country	Gold	Silver	Bronze	Total
Germany	12	16	7	35
United States	10	13	11	34
Norway	11	7	6	24
Canada	6	3	8	17

a. "Germany did the best at the Olympics, with 35 medals, compared to 34 for the United States, 24 for Norway, and 17 for Canada."
b. "Gold, silver, and bronze medals each accounted for about ⅓ of the medal total."
c. "At the 2002 Winter Olympics, the United States won more medals than all other countries, followed by Canada, Germany, and Norway."

3. For each of the following situations, specify whether you would use prose, a table, or a chart.
   a. Statistics on five types of air pollutants in the 10 largest U.S. cities for a government report
   b. Trends in the value of three stock market indices over a one-year period for a Web page
   c. Notification to other employees in your corporation of a change in shipping fees
   d. Distribution of voter preferences for grade-level composition of a new middle school (grades 5–8, grades 6–8, or grades 6–9) for a presentation at a local school board meeting
   e. National estimates of the number of uninsured among part-time and full-time workers for an introductory section of an article analyzing effects of employment on insurance coverage in New York City

4. For each of the situations in the previous question, state whether you would use and define technical terms or avoid jargon.

5. Identify terms that need to be defined or restated for a nontechnical audience.
   a. "The Williams family's income of $25,000 falls below 185% of the Federal Poverty Threshold for a family of four, qualifying them for food stamps."
   b. "A population that is increasing at 2% per year has a doubling time of 35 years."

6. Rewrite the sentences in the previous question for an audience with a fifth-grade education. Convey the main point, not the calculation or the jargon.

7. Read the sentences below. What additional information would someone need in order to answer the associated question?
   a. "Brand X costs twice as much as Brand Q. Can I afford Brand X?"
   b. "My uncle is 6′6″ tall? Will he fit in my new car?"
   c. "New Diet Limelite has 25% fewer calories than Diet Fizzjuice. How much faster will I lose weight on Diet Limelite?"
   d. "It has been above 25 degrees every day. We're really having a warm month, aren't we?"

8. Rewrite each of these sentences to specify the direction and magnitude of the association.
   a. "In the United States, race is correlated with income." See table 2C.

Table 2C. Median income by race and Hispanic origin, United States, 1999

Race/Hispanic origin	Median income
White	$42,504
Black	$27,910
Asian/Pacific Islander	$51,205
Hispanic (can be of any race)	$30,735

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States,* 2001, table 662.

   b. "There is an association between average speed and distance traveled." (Pick two speeds to compare.)
   c. Write a hypothesis about the relationship between amount of exercise and weight gain.

9. Use the GEE approach to describe the patterns in figure 2A, including an introductory sentence about the purpose of the chart before summarizing the patterns.

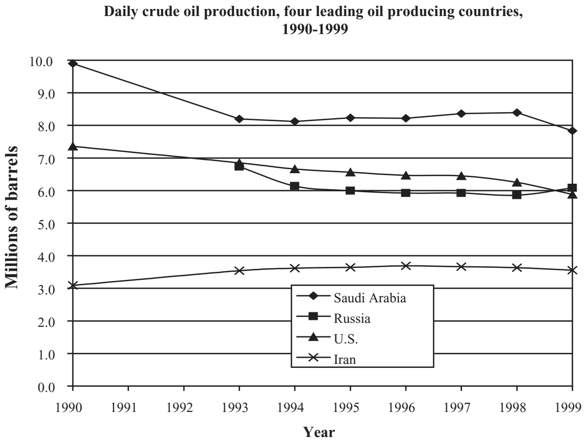


Figure 2A.

2

Seven Basic Principles

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

Find a journal article about an application of a multivariate analysis. Use it to answer the following questions.

1. Is the context (W's) of the study specified? If not, which W's are missing or poorly defined?

2. Evaluate the technical language.
   a. Are definitions provided for all technical and statistical terms that might be unfamiliar to the audience?
   b. Are all acronyms used in the paper spelled out and defined?
   c. Are pertinent synonyms for methods or concepts familiar to the intended audience mentioned?

3. Circle all analogies or metaphors used in the paper. Are they likely to be familiar to the intended audience? If not, replace them with more suitable analogies or metaphors.

4. Identify the major tools (text, tables, charts) used to present numbers in the article.
   a. For one example of each type of tool, identify its intended purpose or task in that context (e.g., presenting detailed numeric values; conveying a general pattern).
   b. Use the criteria in chapter 2 of *Writing about Multivariate Analysis* to evaluate whether it is an appropriate choice for that task. If so, explain why. If not, suggest a more effective tool for that context.

5. Find a numeric fact or comparison in the introduction or conclusion to the article.
   a. Is it clear what question that fact or comparison is intended to answer?
   b. Are the raw data for that fact or comparison presented in the text, a table, or chart?
   c. Are the values interpreted in the text?
   d. Revise the paragraph to address any shortcomings you identified in parts a through c.

6. Find a description of an association between two variables. Are the direction and magnitude of the association specified? If not, rewrite the description.

7. Find a description of a pattern involving more than three values, subgroups, or results of models that are presented in a table or a chart.
   a. Is the purpose of the chart or table explained?
   b. Is the pattern generalized or is it described piecemeal?
   c. Are representative values reported to illustrate the pattern?
   d. Are exceptions to the general pattern identified?
   e. Rewrite the description of the table or chart using the GEE approach to address any shortcomings you identified in parts a through d.

B. WRITING PAPERS

1. For a bivariate association among variables in your data,
   a. Specify which tool you would use to present the findings in a paper for a scientific audience in your field.
   b. Write one to two sentences to describe that association, including the W's, units, direction, magnitude, and statistical significance.
   c. Redo parts a and b to present the same association in a talk to a lay audience.

2. Begin with the introduction.
   a. Write an introduction that integrates the concepts and methods used in your study.
   b. Use the criteria in chapter 2 of *Writing about Multivariate Analysis* to assess use of technical language in your introduction.
   c. Revise your introduction to address any shortcomings you identified in part b.

3. Graph the distribution of a continuous variable in your data set. Describe it using an analogy.

4. Design a chart to portray a three-way association among variables in your data set. Use the GEE approach to describe the pattern.

C. REVISING PAPERS

1. Repeat questions A.1 through A.7 for a paper you have written previously about a multivariate analysis.

2. Have someone who is unfamiliar with your research question peer-edit your answers to question C.1, using the checklist from chapter 2 of *Writing about Multivariate Analysis*. "Editors" should suggest specific sentences, examples, or other changes (e.g., "replace a table with a chart") to replace the material needing revision.

2

Seven Basic Principles

SOLUTIONS

1. “In 1995, the world’s largest city, Tokyo, had a population of 27 million people. With populations of roughly 16.5 million apiece, the next two largest cities, Mexico City and Sao Paolo, were only about 60% as large as Tokyo.”

3. Choice of prose, a table, or a chart for specific situations.
   a. Table to show detailed values and organize the 50 numbers
   b. Multiple-line chart to illustrate approximate pattern
   c. Prose (memo)
   d. Pie chart
   e. Prose (few sentences)

5. Terms that need to be defined or restated for a nontechnical audience are shown in bold.
   a. “The Williams family’s income of $25,000 falls below **185% of the Federal Poverty Threshold for** a family of four, qualifying them for food stamps.”
   b. “A population that is increasing at 2% per year has a **doubling time** of 35 years.”

7. Additional information needed to answer the associated question:
   a. How much does Brand Q (or Brand X) cost? How much money do you have?
   b. How big is the door opening to your car? The headroom and legroom?
   c. How many calories does Diet Fizzjuice (or Diet Limelite) have?
   d. Where are you located? What month is it? Is temperature being measured in degrees Fahrenheit or degrees Celsius?

9. “Figure 2A shows trends in daily crude oil production in the world’s four leading oil-producing countries during the 1990s. Over the course of that decade, Saudi Arabia consistently had the highest crude oil production, followed by Russia, the United States, and Iran. However, downward trends in production in the top three oil-producing countries, coupled with steady production in Iran, led to a narrowing of the gap between those countries between 1990 and 1999. In 1990, Saudi Arabia produced 30% more oil than the United States and more than three times as much as Iran (10 million, 7 million, and 3 million barrels per day, respectively). By 1999, Saudi Arabia’s advantage had decreased to 25% more than the United States or Russia, and about twice as much as Iran.”

3

Causality, Statistical Significance, and Substantive Significance

PROBLEM SET

1. Evaluate whether each of these statements correctly conveys statistical significance. If not, rewrite the sentence so that the verbal description about statistical significance matches the numbers; leave the numeric values unchanged.
   a. There was a statistically significant increase in average salaries over the past three years ($p = .04$).
   b. The p-value for the t-test for difference in mean ozone levels equals 0.95, so we can be 95% certain that the observed difference is not due to chance.
   c. The difference in voter participation between men and women was not statistically significant ($p = 0.35$).
   d. The p-value for the t-test for difference in mean ozone levels equals 0.95. This test shows we can be 95% certain that the difference in ozone levels can be explained by random chance; hence the difference is statistically significant.
   e. The price of gas increased by $0.05 over the past three months, meaning that the p-value = 0.05.
   f. The p-value comparing trends in gas prices = 0.05, hence the price of gas increased by $0.05.
   g. Voter participation was 20% higher among Democrats than among Republicans in the recent local election. Statistical tests show $p < .01$, so we can be 99% certain that the observed difference is not due to chance.
   h. The average processor speed was slightly higher for Brand A than for Brand B; however $p = .09$, so the effect was not statistically significant. If the sample size were increased from 40 to 400, the difference in processor speeds between the two brands would increase, so it might become statistically significant.
   i. The average processor speed was slightly higher for Brand A than for Brand B; however $p = .09$, so the effect was not statistically significant. If the sample size were increased from 40 to 400, the standard error would decrease, so the difference might become statistically significant.

2. For each of the following findings, identify background facts that could help decide whether the effect is big enough to matter. Look up your suggested facts for one of the research questions. What do you conclude about the substantive significance of the finding?
   a. Jo's IQ score increased 2 points in one year.

b. The average response on a political opinion poll for two adjacent counties differed by 2 points. The question was scaled “agree strongly,” “agree,” “neither agree nor disagree,” “disagree,” and “disagree strongly.”
c. The Dow Jones Industrial Index dropped 2 points since this morning.
d. Bed rest is expected to prolong Mrs. Peterson’s pregnancy to 36 weeks from 34 weeks gestation.

3. Discuss whether each of the following research questions involves a causal relationship. If the relationship is causal, describe one or more plausible mechanisms by which one variable could cause the other. If the relationship is not causal, give alternative explanations or mechanisms for the association.
a. April showers bring May flowers.
b. People with blue eyes are more likely to have blond hair.
c. Pollen allergies increase rapidly with longer daylight hours.
d. Eating spicy foods is negatively correlated with heartburn.
e. Prices and sales volumes are inversely related.
f. Fair-skinned people sunburn faster than do those with dark skin.
g. Average reading ability increases dramatically with height between 4′ and 5′.

4. For each of the studies summarized in table 3A
a. explain how would you describe the findings in the results section of a scientific paper;
b. identify the criteria you used to decide how to discuss the findings for that study.

Table 3A. Hypothetical study results

Topic I: Effect of new mathcurriculum on test scores*	Effect size	Statistical significance (*p*-value)	Sample size
Study 1	+½ point	$p < .01$	1 million
Study 2	+½ point	$p = .45$	1 million
Study 3	+5 points	$p < .01$	1 million
Study 4	+5 points	$p = .07$	1 hundred
Study 5	+5 points	$p = .45$	1 million
Topic II: Effect of white hair on mortality**			
Study 1	+ 5%	$p < .01$	1 million
Study 2	+ 5%	$p = .45$	1 million
Study 3	+50%	$p < .01$	1 million
Study 4	+50%	$p = .07$	1 hundred
Study 5	+50%	$p = .45$	1 million

* Effect size for math curriculum studies = scores under new curriculum – scores under old curriculum.

** Effect size for hair color studies = death rate for white-haired people – death rate for people with other hair colors.

5. For each of the topics in table 3A, indicate whether you would recommend a policy or intervention based on the results, and explain the logic behind your decision.

3

Causality, Statistical Significance, and Substantive Significance

SUGGESTED COURSE EXTENSIONS

■ A. REVIEWING

1. In a journal article in your field, find an example of a highly correlated association.
   a. Is that association causal? Why or why not?
   b. List facts or comparisons that could be used to evaluate the substantive meaning of the association.

2. In a journal article in your field, find an association with a low correlation or nonstatistically significant association.
   a. Is that association causal? Why or why not?
   b. List facts or comparisons that could be used to evaluate whether the association is substantively meaningful.

3. Find a journal article that uses multivariate regression to analyze a policy problem and proposes one or more solutions to that problem.
   a. Evaluate how well the article addresses each of these aspects of "importance." Does the article
      i. specify a cause-and-effect type of relationship?
      ii. provide a plausible argument for a causal association?
      iii. discuss bias, confounding, or reverse causation?
      iv. report results of statistical tests for that association?
      v. assess whether the expected benefits of the proposed solution are big enough to outweigh costs or otherwise matter in a larger social context?
   b. Given your answers to part a, write a short critique of the appropriateness of the proposed solution.

4. Repeat question A.3 with an article in the popular press about a scientific or policy problem and solution that is currently being touted for implementation.

B. WRITING AND REVISING

1. Identify an aspect of your research question that involves the association between an independent and dependent variable. Is that association causal?
   a. If so, describe the mechanisms through which the hypothesized causal variable affects the hypothesized outcome variable.
   b. If not, explain how those variables could be correlated. Identify possible bias, confounding factors, or reverse causation.
   c. Rewrite your research question as a hypothesis, making it clear whether the association you are studying is expected to be causal.
   d. What background facts could you find to help assess the substantive meaning of that association? Look them up and make the assessment.
   e. Write a description of the substantive importance of the association for a discussion section of a scientific paper.
   f. Write a statement for a lay audience, explaining the nature of the association between the variables.

2. For one or two key statistical results pertaining to the main research question in your paper, identify ways to quantify the broad social or scientific impact of that finding.
   a. Locate statistics on the prevalence of the phenomenon you are studying.
   b. Find information on the consequences of the issue. For example, what will it cost in money, time, or other resources? What are its benefits? What does it translate into in terms of reduced side effects, improved skills, or other dimensions suited to your topic?
   c. Use information from parts a and b in conjunction with measures of effect size and statistical significance to make a compelling case for or against the importance of the topic.

3

Causality, Statistical Significance, and Substantive Significance

SOLUTIONS

1. Evaluation of whether the statements correctly convey statistical significance.
   a. Correct.
   b. Incorrect. A *p*-value of 0.95 corresponds to only a 5% probability that the observed difference is not due to chance (e.g., a 95% probability that the observed difference is due to chance.) "The *p*-value for the *t*-test for difference in mean ozone levels equals 0.95, so we can be 95% certain that the observed difference is due to chance."
   c. Correct.
   d. Correct.
   e. Incorrect. This sentence doesn't reveal anything about statistical significance of that change. The most we can say from the information given is "The price of gas increased by $0.05 over the past three months."
   f. Incorrect. Test-statistics and *p*-values are indicators of statistical significance. They do not measure the size of the association, in this case, absolute difference between two values, which cannot be calculated from the information given. The most we can say is "The *p*-value comparing trends in gas prices = 0.05."
   g. Correct.
   h. Incorrect. Sample size does not affect size of a difference between values, in this case, difference in average processor speeds. See part i of this question for correct wording.
   i. Correct.

3. Discuss the causal or noncausal relationships in the presented research questions.
   a. Causal (partly). The flowers will bloom in May whether or not it rains in April, but will bloom more nicely if it rains.
   b. Non-causal association. In many populations, blue eyes and blond hair co-occur but neither causes the other.
   c. Spurious. Positive correlations between both pollen allergies and daylight with more flowers blooming cause a spurious association between allergies and daylight. In other words, if you could have more daylight without more blooming plants, there wouldn't be an association of daylight hours with pollen allergies.
   d. Could be causal or reverse causal. For example, people with heartburn might stop eating spicy foods if they think those foods irritate their heartburn.

e. Reverse causal. Low prices probably induced greater sales. Could be causal in the long run if greater sales allow economies of scale in production, which in turn could lower prices.

f. Causal. Lack of protective pigment in fair-skinned people allows them to sunburn faster.

g. Spurious. Both reading ability and height increase dramatically with children's age, which in turn is positively related to number of years of education. Education is the cause of improved reading ability. Comparing kids of the same age or years of education but different heights would likely show much less difference in reading abilities than if age isn't taken into account.

5. For both topics I and II in table 3A, the findings of studies 1 and 3 are statistically significant, studies 2 and 5 are not, and study 4 is borderline because the *p*-value is slightly above 0.05 and the sample size is small. However, the white hair/mortality association in topic II is spurious, so substantive and statistical significance are irrelevant. For topic I (curriculum change and test scores), where there is a plausible causal explanation, only the findings of study 3 are likely to be of substantive interest because the effect size in study 1 is so small.

4

Five More Technical Principles

PROBLEM SET

1. For each of the following topics, indicate whether the variable or variables used to measure it are continuous or categorical, and single or multiple response.
   a. Respondent's current marital status
   b. Respondent's current number of siblings
   c. Siblings' current heights
   d. Current marital status of siblings
   e. Temperature at 9 A.M. today
   f. The forms of today's precipitation

2. A new school is being considered in your hometown. Several possible grade configurations are being considered (Plan A: grades K–3, 4–5, 6–8, 9–12; Plan B: grades K, 1–4, 5–7, 8–12). The current configuration is K–5, 6–9, and 10–12. Design a question to collect information from school principals on the age distribution of students, making sure the data collection format provides the detail and flexibility needed to compare the different scenarios for the district now and in five years.

3. In a health examination survey, several hundred girls aged five to ten years were measured with a metric measuring tape marked in increments of millimeters. The estimated coefficient on age (years) from an OLS model of height was reported as 5.06666667 centimeters. Write a sentence to report that coefficient.

4. In a microbiology lab exercise, the size of viral cells being compared ranged from 0.000000018 meters (m) in diameter for Parovirus to 0.000001 m in length for Filoviridae (American Society for Microbiology 1999). What scale would you use to report those data in a table? In the text?

5. Write one or two sentences to compare the four specimens in table 4A. Which specimen is the heaviest? The lightest? By how much do they differ? What information do you need before you can make the comparison?

Table 4A. Mass of four specimens

Specimen	Mass
1	1.2 pounds
2	500 grams
3	0.7 kilograms
4	12 ounces

6. For each of the figures 4.3a through 4.3e (*Writing about Multivariate Analysis,* 64–66), choose
   a. a typical value;
   b. an atypical value;
   c. a plausible contrast (two values to compare).

   Explain your choices, with reference to range, central tendency, variation, and skewness.

7. Identify pertinent standards or cutoffs for each of the following questions.
   a. Does Mr. Jones deserve a speeding ticket?
   b. Is the new alloy strong enough to be used for the library renovations?
   c. How tall is five-year-old Susie expected to be next year?
   d. Does Vioxx increase the odds of a heart attack?
   e. Is this year's projected tuition increase at Public U unexpected?
   f. Should we issue an ozone warning today?

8. Indicate whether each of the following sentences correctly reflects table 4B. If not, rewrite the sentence so that it is correct. Check both correctness and completeness of the data.
   a. Between 1964 and 1996, there was a steady decline in voter participation, from 95.8% in 1964 to 63.4% in 1996.
   b. Voter turnout was better in 1996 (63.4%) than in 1964 (61.9%).
   c. Almost all registered voters participated in the 1964 United States presidential election.
   d. The best year for voter turnout was 1992, with 104,600 people voting.
   e. Less than half of the voting age population voted in the 1996 presidential election.
   f. A higher percentage of the voting-age population was registered to vote in 1996 than in 1964.

Table 4B. Voter turnout, United States presidential elections, 1964 through 1996

Year	Total Vote (1000s)	Registered Voters (RV) (1000s)	Vote/RV (%)	Voting Age Pop. (VAP) (1000s)	Vote/VAP (%)
1964	70,645	73,716	95.8	114,090	61.9
1968	73,212	81,658	89.7	120,328	60.8
1972	77,719	97,329	79.9	140,776	55.2
1976	81,556	105,038	77.6	152,309	53.5
1980	86,515	113,044	76.5	164,597	52.6
1984	92,653	124,151	74.6	174,466	53.1
1988	91,595	126,380	72.5	182,778	50.1
1992	104,600	133,821	78.2	189,529	55.2
1996	92,713	146,212	63.4	196,511	47.2

Source: Institute for Democracy and Electoral Assistance 1999.

9. A billboard reads: “1 in 250 Americans is HIV positive. 1 in 500 of them knows it.”
   a. According to the two statements above, what share of Americans are HIV positive and know it? Does that seem realistic?
   b. Rewrite the second statement to clarify the intended meaning
      i. as a fraction of HIV-positive Americans;
      ii. as a fraction of all Americans.

10. An advertisement for a health education program included figure 4A to show the prevalence of two common health behavior problems among teenaged girls. What is wrong with the graph?

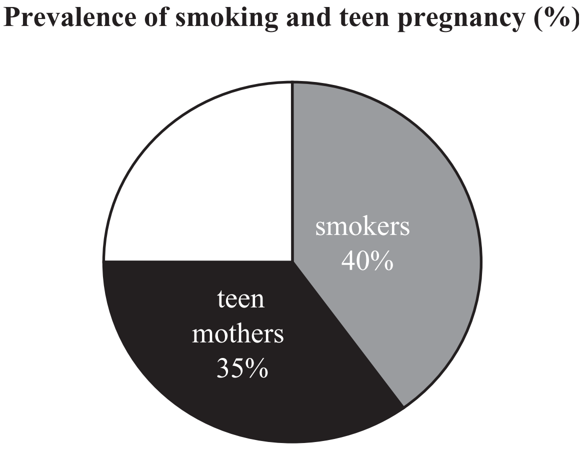


Figure 4A.

11. You are involved in a research team that is conducting a study of commuting. One of the team members submits the following question to be included on the questionnaire:

    "How do you usually commute to work?
    Car __ Public transportation __ Train __ Carpool __ Walk __"

    a. Critique the wording of the question using the guidelines in chapter 4 of *Writing about Multivariate Analysis*.
    b. Revise the question to correct the problems you identified in part a.

12. What is wrong with the following fictitious set of instructions for authors from a scientific journal? "In the interest of saving space, round all numeric results to the nearest single decimal place."

13. Each of these statements contains an error. Identify the problem and rewrite the statement to correct the error. If additional information would be needed to make the correction, indicate what kind of information is needed.

    a. The proportionate increase in income during the 1990s was 20%.
    b. Male infants outnumbered females (sex ratio at birth = 0.95).
    c. A majority of respondents (0.67) agreed that there should be a waiting period before buying a gun.
    d. Cancer accounted for two out of every ten deaths, equivalent to a death rate of 20%.

4

Five More Technical Principles

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. In a journal article in your field, find a discussion of an association between two or three variables. For each of those variables, identify
   a. the type of variable (nominal, ordinal, interval, or ratio);
   b. whether it is single- or multiple-response.
   c. For continuous variables, identify
      i. the system of measurement;
      ii. the unit of analysis;
      iii. the scale of measurement;
      iv. the appropriate number of digits and decimal places for reporting the mean value in the text and a table.
   d. For categorical variables, list the categories for each variable.
   e. If the items requested in c and d aren't described in the article, list plausible versions of that information. For example, if you are studying family income in the United States, you would expect the system of measurement to be United States dollars, the unit of analysis to be the family, and the scale of measurement to be either dollars or thousands of dollars.

2. Read the article's description of the variables you listed in question A.1. Does it provide the information about the distribution of that type of variable that is recommended in chapter 4 of *Writing about Multivariate Analysis*? If not, what additional information is needed?

3. Read the literature in your field to determine whether standard cutoffs or standard patterns are used to assess one of the variables in the association you listed in question A.1. Find a reference source that explains its application and interpretation.

B. APPLYING STATISTICS

1. Repeat question A.1 using variables available in your database.

2. Using the same data,
   a. calculate the frequency distribution for each variable;
   b. create a simple chart of the distribution;
   c. select and calculate the appropriate measure of central tendency for that type of variable;

d. determine whether the measure of central tendency calculated in part c typifies the overall distribution. Why or why not? If not, what is a more typical value?
e. for continuous variables, identify the minimum and maximum values and the first and third quartiles of the distribution.

3. For one of the variables in your database, repeat question A.3. Use the standard or cutoff to classify or evaluate your data (e.g., what percentage of cases falls below the cutoff? Does the distribution of that variable in your data follow the expected pattern?)

4. Compare the eligibility thresholds for your state's State Children's Health Insurance (S-CHIP) for the most recent year available against the Federal Poverty Thresholds (see Web sites for your state's S-CHIP program and the "Poverty" page on the *U.S. Census* Web site). What is the highest income that would qualify for free S-CHIP benefits for a family of one adult and one child? a family of one adult and two children? a family of two adults and two children?

4

Five More Technical Principles

SOLUTIONS

1. Identify the variable(s) as continuous or categorical, and single or multiple response.
   a. Categorical, single-response
   b. Continuous, single-response
   c. Continuous, multiple-response
   d. Categorical, multiple-response
   e. Continuous, single-response
   f. Categorical, multiple-response

3. "The model suggests that on average, girls grow approximately 5.07 centimeters per year between the ages of five and ten."

5. All measurements must be converted into consistent units (scale and system of measurement). I chose to convert all measurements to kilograms (see revised table 4A), using the conversion factor 2.2 pounds/kilogram.

   "Of the four specimens compared here, specimen 3 is the heaviest (0.70 kilograms). It is about twice as heavy as the lightest (specimen 4, 0.34 kg). The other two specimens were each about 70% as heavy as speci-
   men 3."

Table 4A. Mass of four specimens

Specimen	Weight (original units)	Weight (kg)
1	1.2 pounds	0.54
2	500 grams	0.50
3	0.7 kilograms	0.70
4	12 ounces	0.34

7. Identify pertinent standards or cutoffs.
   a. The speed limit where he was driving and his actual speed
   b. The weight-bearing capacity of the alloy (in weight per unit area) and the expected weight load (again, in weight per area) in the library
   c. Her current height and a growth chart (height for age) for girls
   d. The odds ratio for Vioxx users versus non-Vioxx users, compared to an odds ratio of 1.0 (the null hypothesis of equal odds in both groups)

e. The rate of inflation, current tuition, and rates of tuition increase at Public U over the past few years

f. Today's ozone measurement and the cutoff for an ozone warning

9. a. Taken together, the two statements imply that 1 in 125,000 Americans are HIV positive and know it, clearly a misstatement of the facts.

   b. Rewrite the statement to clarify.

      i. "Half of HIV-positive Americans know they are infected."

      ii. "One in 500 Americans is HIV positive and knows it."

11. Critique the commuting questionnaire question.

    a. First, the responses are not mutually exclusive. For example, "car" and "carpool" overlap, as do "public transportation" and "train." Second, the responses aren't exhaustive, excluding bus and bicycle, among other possibilities, and omitting an "other (specify)" response. Third, they don't provide a way for people to record more than one mode of transportation. Fourth, there is no appropriate response for people who don't work or those who work at home. And finally, there are no instructions given about how many responses are allowed.

    b. "How do you usually commute to work? (Mark all that apply.)
    Car ____ Train ____ Bus ____ Bicycle ____ Walk ____
    Other (specify) ____________ I work at home ____ I do not work ____"

13. Identify the errors and rewrite.

    a. Proportion and percentage are not consistent units. Either write "The proportionate increase in income during the 1990s was 0.20." or "Income increased by 20% during the 1990s."

    b. The reported sex ratio indicates a lower number in the numerator than the denominator. Either write "Male infants outnumbered females (sex ratio at birth = 1.05 males per female)" (flipping over the ratio to be consistent with the wording, and reporting units as males per female) or "There were slightly fewer male than female infants (sex ratio at birth = 0.95 males per female)" (revising the wording to be consistent with the numeric value, and reporting units as males per female).

    c. The value 0.67 does not indicate a majority unless labeled as a proportion. Better to express the value as a percentage. Write "A majority of respondents (67%) agreed that there should be a waiting period before buying a gun."

    d. A death rate is expressed relative to the population (e.g., number of living people), not as a percentage of deaths (e.g., relative to the total number of deaths). Unless the total population and number of deaths are known, the first half of the sentence doesn't include enough information to calculate the death rate. Write "Cancer accounted for two out of every ten deaths."

5

Creating Effective Tables

PROBLEM SET

1. Write a title for table 5A.

Table 5A.

Year	Median age (years)
1960	
1970	
1980	
1990	
2000	

Source: U.S. Census of Population, various dates.

2. Answer the following questions for tables 5.2 through 5.7 in *Writing about Multivariate Analysis*.
   a. Who is described by the data?
   b. To what date or dates do the data pertain?
   c. Where were the data collected?
   d. What are the units of measurement? Are they the same for all cells in the table?
   e. Where in the table are the units of measurement defined?
   f. Does the table use footnotes? If so why? If not, are any needed?
   g. Are panels used within the table? If so, why? If not, would the addition of panels improve the clarity of the table?

3. Table 5B needs several footnotes to be complete. What information would those footnotes provide?

Table 5B. Estimated OLS coefficients and standard errors from a model of BMI by demographic factors and health behaviors, Dietville, 2003

	Coefficient	Standard error
Intercept	19.03**	1.27
Age (years)		
Female		
Income level		
Poor		
Near poor		
Nonpoor		
Smoking		
No		
<1 pack/day		
1+ packs/day		
Exercise (days/week)		
<1		
1–2		
3+		
R^2	0.28	
F-statistic	4.21*	

4. What is missing from table 5C?

Table 5C. Results of an OLS model of log(poverty rate)

State median wage	–0.174	0.043
State median wage, squared	0.006	0.002
Log(state – federal EITC)	0.023	0.015
Log(state – federal minimum wage)	–0.015	0.011
Log(max state AFDC/FSP benefit)	0.543	0.194

5. Design a table for each of the following topics. Provide complete labeling and notes, show column spanner and panels if pertinent, and indicate what principle(s) you would use to organize items within the rows and/or columns.
   a. Age (years), gender, race, and educational attainment composition of a study sample.
   b. Bivariate measures of association between height (cm), weight (kg), percentage body fat, systolic blood pressure (millimeters of mercury [mm Hg]), and resting pulse (beats per minute).
   c. Results of logistic regression models of chances of high school graduation in the United States in 1998, stratified by gender and residence (urban versus rural). The key independent variables are mother's and father's educational attainment and occupation. Other control vari-

ables include race, family income, and number of siblings. Report effect size as odds ratios; statistical significance with *z*-statistics and symbols.

d. Projected number of people receiving college degrees by region of the country from 2010 to 2025 under three different scenarios about rates of college attendance and completion.

e. Net effects of an interaction between tercile of a student's own high school class rank and his or her mother's educational attainment (<HS, =HS, >HS) on the student's first-year college grade point average (GPA). Results are based on an OLS regression controlling for gender, race, and family income, using data from the high school classes of 1995 through 2000. Report results of inferential statistical tests using symbols, with the highest tercile of each independent variable as the reference category.

6. A journal for which you are writing an article allows no more than two tables, but your current draft has three. Combine tables 5D and 5E below into one table of 18 or fewer rows.

Table 5D. Number of wildfires by month, United States, 1998–2000

Month	1998	1999	2000	30-year average[a]
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

[a] 1970–1999.

Table 5E. Number of acres consumed by wildfire, by month, United States, 1998–2000

Month	1998	1999	2000	30-year average[a]
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

[a] 1970–1999.

7. There are at least seven things wrong with the labeling of table 5F. Identify and suggest ways to correct each error. Note: All numbers are correct.

Table 5F. Results of a logistic regression of political party preference, Whatnation, 2004

Variable	Odds ratio	Confidence interval	Wald chi-square
Age group 2	1.82	–0.015–3.83	4.13
Age group 3	2.01	–0.25–5.19	3.67
Race	0.53	–1.31–1.03	5.99
Proportion poor			
<10	1.26	–0.51–2.64	0.67
10–19	2.36	0.04–5.36	7.25
20–29			
>29	0.35	–2.02–0.93	7.69

5

Creating Effective Tables

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. Find a simple table in a newspaper or magazine article. Evaluate whether it can stand alone without the text. Suggest ways to improve labeling and layout.

2. In a journal article from your field, find a table of regression results.
   a. Evaluate whether you can interpret all the numbers in the table without reference to the text. Suggest ways to improve labeling and layout.
   b. Using information in the article, revise the table to correct those errors.
   c. Consider whether a different table layout would work more effectively.
   d. Assess whether additional tables are needed in the paper, to present net effects of an interaction, convey nonlinear specifications, or illustrate effects of multiunit changes in an independent variable, for example (see chapter 9 of *Writing about Multivariate Analysis*).
   e. Pick a chart from the article. Draw a rough draft of a table to present the same information. Show what would go into the rows and columns, whether the table would have spanners or panels, and write complete title, labels, and notes.

B. APPLYING STATISTICS

1. Create a table to display univariate statistics for your main dependent variable and three or more independent variables that you later use in your multivariate model (see question B.3).

2. Create a table to show bivariate associations (e.g., correlations, cross-tabulations, or a difference in means) among the variables you selected for question B1.

3. Create a table to show coefficients, standard errors, and model goodness-of-fit statistics from three nested models of the association between the variables you selected for question B1.

4. Make a list of two or three simple tables to show two-way or three-way associations that pertain to your research question. Write individualized titles for each table.

5. Obtain a copy of the instructions for authors for a leading journal in your field. Revise the tables you created in questions B.1 through B.3 to satisfy their criteria.

C. WRITING AND REVISING

1. Evaluate a table of bivariate statistics that you created previously for a paper, using the checklist in chapter 5 of *Writing about Multivariate Analysis* and the instructions for authors for a leading journal in your field.

2. Evaluate a table of regression results that you created previously for the same paper, again using the checklist from chapter 5 and the instructions for authors for your selected journal.

3. Peer-edit someone else's bivariate and multivariate tables after he or she has revised them, using the checklist in chapter 5 and the instructions for authors for his or her selected journal.

4. Read through the results section of a paper you have written previously. Identify topics or statistics for which to create additional tables to present net effects of interactions, nonlinear specifications, or multiunit changes related to your multivariate model. Draft them with pencil and paper, including complete title, labels, and notes.

5

Creating Effective Tables

SOLUTIONS

1. Title for table 5A: “Median age of the U.S. population, 1960 to 2000.”

3. Notes to table 5B.

   Spell out BMI (body mass index), show the formula, and provide a citation.

   Specify numeric cutoffs for income or the income-to-poverty ratio to define “poor,” “near poor,” and “nonpoor.”

   Define what * and ** denote.

   Cite the data sources.

5. Design tables for the given topics.
   a. Title: “Age, gender, race, and educational attainment composition of [fill in who, when, and where for study sample].” Table structure: Demographic variables in the rows, with units specified in row header for age, subgroups for the categorical variables shown with indented row headings. Columns for number of cases and percentage of cases. Note citing data source.
   b. Title: “Pearson correlation coefficients between height, weight, percentage body fat, systolic blood pressure, and resting pulse, [W’s].” Table structure: one row and one column for each variable, with label indicating units or footnote callout for abbreviated units. Correlations reported in the below-diagonal cells (see *Writing about Multivariate Analysis,* table 5.7, p. 98, for an example). Symbols in the table cells to identify $p < 0.05$, with a note to explain the meaning of the symbol. Another note to define unit abbreviations
   c. Title: “Estimated odds ratios and z-statistics from a logistic regression of high school graduation, by gender and residence, United States, 1998.” Mother’s and father’s educational attainment and occupation in the top rows, followed by other independent variables. Column spanner for each gender over columns for urban and rural (total of four models), with z-statistics in parentheses below odds ratios for each independent variable with symbols denoting $p < 0.01$ and $p < 0.05$. Goodness of fit statistics and degrees of freedom for each model in rows at bottom of the table. Footnotes citing data sources, symbols.
   d. Title: “Low, medium, and high projections of number of college degrees earned (thousands), by region, United States, 2010 to 2025.” Columns for low, medium, and high with a spanner labeled “scenario,” rows for years. Notes about data sources, assumptions used in each scenario.

e. Title: “Net effects of an interaction between student’s high school class rank and mother’s educational attainment on student’s first-year college grade point average, high school classes of 1995 to 2000.” One column each for bottom, middle, and top tercile of class rank with a column spanner labeled “class rank,” one row for each level of mother’s education (<HS, =HS, >HS). Interior cells include estimated values of first-year college GPA to nearest two decimal places with symbols denoting statistical significance. Notes specifying data source and other variables controlled in the model (or naming a table in which those estimates are shown), identifying the top terciles as the reference category, and defining symbols used to denote statistical significance.

7. Errors are labeled in the table using lettered superscripts keyed to the comments below.

Table 5F. Results of a logistic regression of political party preference,[a] Whatnation, 2004

Variable	Odds ratio	Confidence interval[b, c, d]	Wald chi-square
Age group 2[e]	1.82	–0.015–3.83	4.13
Age group 3	2.01	–0.25–5.19	3.67
Race[f]	0.53	–1.31–1.03	5.99
Proportion poor[g]			
<10	1.26	–0.51–2.64	0.67
10–19	2.36	0.04–5.36	7.25
20–29[h]			
>29	0.35	–2.02–0.93	7.69

Comments on errors in table 5F:

a. The category of the dependent variable being modeled is not specified, so it is unclear whether the regression is estimating relative odds of a Democratic party preference or a Republican party preference.

b. The width of the confidence interval isn’t specified. (The correct value is 99% CI.)

c. The confidence intervals are specified in terms of log-odds, not odds ratios. (You can tell because odds ratios can never be below 0, but the corresponding log-odds will be <0.0 whenever OR<1.0.) Either report log-odds instead of odds ratios and keep the current CI, or calculate the CI in terms of odds ratios.

d. Using a dash (“–”) to separate confidence limits that include negative values is confusing. Replace the dash with a comma, e.g., –0.015, 3.83

e. The reference category for age group isn’t included in the table, and the labels for the other age groups don’t provide enough information for readers to infer the identity of the reference category.

f. The identities of the included and reference categories of the race dummy variable cannot be determined by the row label “Race.”
g. Proportions must be between 0.0 and 1.0, therefore the reported values are probably percentages. Either change the label to read “Percentage poor,” or convert the values to proportions and label accordingly (e.g., < 0.10, 0.10–0.19).
h. The reference category could be more clearly marked using one of the conventions mentioned on page 87 of *Writing about Multivariate Analysis*. Identify the convention with a note to the table.

6

Creating Effective Charts

PROBLEM SET

1. Note what is missing from the charts in figures 6A and 6B.

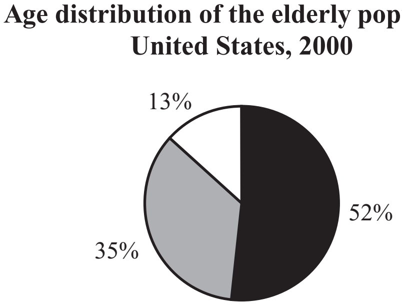


Figure 6A.

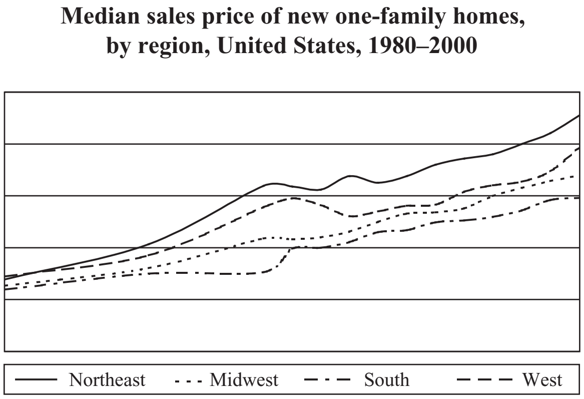


Figure 6B.

2. Answer the following questions for figures 6.4, 6.7a, and 6.13 (pp. 128, 131, and 139) in *Writing about Multivariate Analysis*.
   a. Who is described by the data?
   b. To what date or dates do the data pertain?
   c. Where were the data collected?
   d. What criteria were used to organize the values of the variables on chart axes? (Hint: consider type of variable.)
   e. What are the units of measurement? Are they the same for all numbers shown in the chart?
   f. Are there footnotes to the chart? If so, why? If not, are any needed?

3. For each of the following topics, identify the type of task (e.g., univariate distribution, relationship between two variables, or relationship among three variables), and types of variables to be presented (e.g., nominal, ordinal, interval, ratio), then state which type of chart would be most appropriate, using the guidelines in table 6.1 of *Writing about Multivariate Analysis*.
   a. Projected number of people receiving college degrees by region of the country from 2010 to 2025 under three different scenarios about rates of college attendance and completion
   b. Average commuting costs per month, by mode of transportation (bicycle, bus, car, train, walk, other); one number per type of transportation
   c. Number of cases in a study sample from rural, suburban, and urban areas
   d. Educational attainment distribution (<HS, = HS, >HS) for native-born United States residents and immigrants from other North American countries, Africa, Asia, Australia & New Zealand, Europe, and Latin America in the year 2000
   e. Estimated odds ratios and 95% confidence intervals for gender, major occupation category (blue-collar, white-collar, service, other), and region (four major census regions) from a logistic regression of being laid off in the past year
   f. Net effect of a quadratic specification of percentage body fat in an OLS model of systolic blood pressure (millimeters of mercury [mm Hg])
   g. Net effects of an interaction between tercile of a student's own high school class rank and mother's educational attainment (<HS, =HS, >HS) on the student's first-year college grade point average (GPA). Results are based on an OLS regression controlling for gender, race, and family income, using data from the high school classes of 1995 through 2000. The top tercile of each variable in the interaction is the reference category.

4. For each of the topics in question 3 that involve an *XY* chart, indicate which principle you would use to decide what order to display values on the *x* axis; see pages 108–11 of *Writing about Multivariate Analysis* for a list of organizing principles.

5. Create a stacked bar chart to present the data shown in table 6A, allowing the bar height to vary to show total number of ozone days. To help you plan your chart, answer the following questions, then draw an approximate stacked bar chart, allowing the level to vary by county.
   a. Which variable goes on the *x* axis, and what principle would you use to organize its values?
   b. Which variable goes in the slices (and legend)?
   c. Which variable goes on the *y* axis, and in what units is it measured?
   d. What is the title for the chart?

Table 6A. Number of unhealthy ozone days by level of warning for selected counties in Indiana, 1996–1998

	Level of warning[a]		
	Unhealthy for sensitive groups	Unhealthy	Very unhealthy
Allen	25	0	0
Clark	29	3	1
Elkhart	15	0	0
Floyd	27	6	0
Hamilton	31	3	0
Hancock	28	2	0
Lake	29	2	0
La Porte	26	6	1
Madison	27	3	0
Marion	32	3	0
Porter	25	3	0
Posey	14	1	0
St. Joseph	21	1	0
Vanderburgh	32	2	0
Vigo	25	1	0
Warrick	40	3	0

[a] Unhealthy for sensitive groups = 0.085–0.104 parts per million (ppm); Unhealthy = 0.105–0.124 ppm; Very unhealthy = 0.125–0.374 ppm.

Source: American Lung Association.

6. Revise your chart from the previous question to illustrate the relative importance (share) of different levels of ozone warning in each county.
   a. What aspects of each chart remain the same as in the previous question? What aspects change?
   b. What are the advantages and disadvantages of the two versions of the chart? Be specific for this topic and data.

7. Fussell and Massey (2004) used data from the Mexican Migration Project to study relationships among demographic factors, human capital, social capital in the family and community, and migration from Mexico to the United States (table 6B). Use that information to create charts showing the following patterns. Hint: use a spreadsheet, following the guidelines in appendix B of *Writing about Multivariate Analysis*.
   a. The association between age in years and relative odds of first trip to the United States, compared to 15-year-olds. Allow age to vary from 15 to 64 years.
   b. The association between migration prevalence ratio and relative odds of first trip to the United States, with 95% confidence intervals.

Table 6B. Estimated log-odds of first trip to the United States, Men, 1987–1998 Mexican Migration Project

	Log-odds	Standard error
Demographic background		
Age (years)	–0.003	0.02
Age-squared	–0.001	0.0002
Ever married	–0.09	0.06
Number of minor children in household	0.01	0.01
Human capital		
Years of education	–0.04	0.006
Months of labor-force experience	–0.002	0.0007
Social capital in the family		
Parent a prior U.S. migrant	0.51	0.05
Siblings prior U.S. migrants	0.36	0.02
Social capital in the community		
Migration prevalence ratio[a]		
0–4	–0.99	0.15
5–9	–0.09	0.12
(10–14)		
15–19	0.35	0.10
20–29	0.57	0.13
30–39	0.95	0.15
40–59	0.74	0.19
60 or more	0.34	0.15
Intercept	–3.31	0.26
– 2 log likelihood	23,369.2	
Df	26	

Source: Adapted from Elizabeth Fussell and Douglas S. Massey, "The Limits to Cumulative Causation: International Migration from Mexican Urban Areas," *Demography* 41.1 (2004): 151–71. Table 2, http://muse.jhu.edu/journals/demography/v041/41.1fussell.pdf.

Note: Model also includes controls for occupational sector, internal migratory experience, community characteristics, and Mexican economic and U.S. policy context.

[a] The migration prevalence ratio = (the number of people aged 15+ years who had ever been to the U.S./the number of people aged 15+ years) ×100.

8. Use the data in table 5.5 (*Writing about Multivariate Analysis,* 95) to create a chart comparing the racial composition of the NHANES III study sample to that of all U.S. births. Include a complete title, labels, legend, and notes.

9. In a study of sexual behavior among youths in Kenya, Mensch and colleagues (2003) evaluated whether audio computer-assisted self-interviewing (ACASI) produces more valid reporting of sexual activity and related sensitive behaviors than face-to-face interviews or self-administered written interviews. Their results are reported in table 6C. Use that information to create charts
   a. to accompany a GEE description of whether reporting a sensitive behavior differs by mode of interview among boys;
   b. to accompany a GEE description of whether the association between mode of interview and reporting having had more than one sexual partner differs by gender.

Table 6C. Odds ratios from logistic regressions of reporting sensitive behaviors, by mode of interview and gender, Kisumu District, Kenya, 2002

Behavior	Boys	Girls
Ever had a boyfriend or girlfriend		
Interviewer-administered	1.00	1.00
Self-administered	0.78	0.82
ACASI[a]	0.43***	0.69*
Ever had more than one sexual partner		
Interviewer-administered	1.00	1.00
Self-administered	1.02	0.72
ACASI[a]	1.28	2.35***
Ever had sex with a stranger		
Interviewer-administered	1.00	1.00
Self-administered	1.43	1.24
ACASI[a]	2.42**	4.25***
Ever tricked/coerced/forced into sex		
Interviewer-administered	1.00	1.00
Self-administered	2.33***	1.89**
ACASI[a]	2.40***	3.35***

Source: Adapted from Barbara S. Mensch, Paul C. Hewett, and Annabel S. Erulkar, "The Reporting of Sensitive Behavior by Adolescents: A Methodological Experiment in Kenya," *Demography* 40.2 (2003): 247–68, table 2, *http://muse.jhu.edu/journals/demography/v040/40.2mensch.pdf*.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] ACASI = audio computer-assisted self-interviewing.

6

Creating Effective Charts

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. In a journal article from your field,
   a. Find a chart that presents the relationship between two variables. Use table 6.1 in *Writing about Multivariate Analysis* (pp. 150–154) to assess whether that type of chart is appropriate for the types of variables involved.
   b. Evaluate whether you can understand the meaning of the numbers in the chart based only on the information in the chart. Suggest ways to improve labeling and layout.
   c. Using information in the article, revise the table to correct those errors.
   d. Consider whether a different chart format would be more effective.
   e. Pick a table from the article. Draft a chart to present the same information, including complete title, axis labels, legend, and notes.

2. Repeat questions A.1a through A.1d with a chart that portrays the relationship among three variables (e.g., two independent variables and a dependent variable).

B. APPLYING STATISTICS

1. Create a chart to show the frequency distribution of a variable from your data set. See table 6.1 in *Writing about Multivariate Analysis* (pp. 150–154) to decide on the best format of chart for the type of variable.

2. Estimate a difference in means for a continuous dependent variable according to values of a categorical independent variable. Create a chart to present the results, using the checklist in chapter 6 of *Writing about Multivariate Analysis*.

3. Estimate a logistic regression model of a binary dependent variable as a function of three or four dummy variables. Using the criteria on pages 140–141 of *Writing about Multivariate Analysis,* create a chart to show the 95% confidence intervals around the log-odds estimate for each of the independent variables, including a reference line to convey the null hypothesis.

4. Complete questions B.2b, B.4c, and B.5c in the suggested course extensions for chapter 9 (pages 66–67) of the *Study Guide to Writing about Multivariate Analysis*).
5. Obtain a copy of the instructions for authors for a leading journal in your field. Revise the charts you created in questions B.1 through B.3 to satisfy their criteria.

■ C. WRITING AND REVISING

1. Evaluate a chart you created previously for a paper about a multivariate analysis, using the checklist for chapter 6 in *Writing about Multivariate Analysis* and the instructions for authors for your selected journal.

2. Peer-edit another student's charts after he or she has revised them, again using the checklist and the instructions for authors for their selected journal.

3. Read through a results section you have written previously. Identify topics or statistics for which to create additional charts such as net effects of interactions or multiterm specifications from your multivariate model. Draft them using pencil and paper, including complete title, labels, legend, and notes.

4. Identify a table or portion of a table in your paper that would be more effective as a chart. Draft that chart, including complete title, labels, legend, and notes.

6

Creating Effective Charts

SOLUTIONS

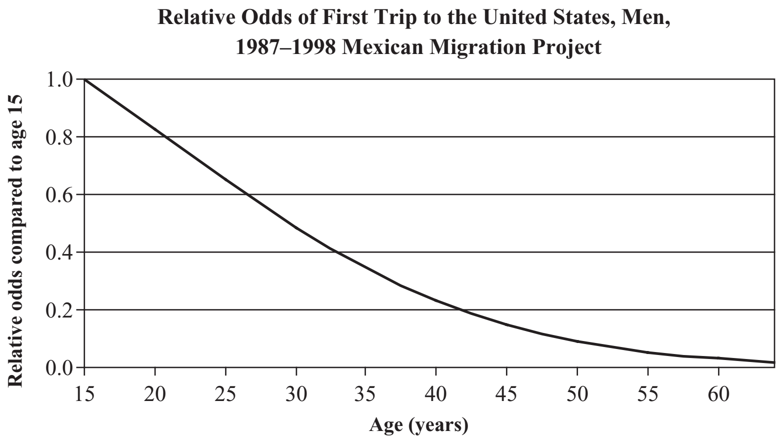
1. Figure 6A is missing a legend; 6B is missing axis titles, axis labels, and units of measurement.

3. Identify the task and types of variables, then state the appropriate type of chart.
   a. Three-way association between one continuous and one nominal predictor (date and type of scenario, respectively), and a continuous outcome (number of people receiving degrees). Multiple-line chart, to show projected number by date (on the *x* axis) in the number of people receiving college degrees (on the *y* axis), with different lines and line styles for low, medium, and high scenarios (identified in the legend). Notes about data sources and assumptions used in each scenario.
   b. Two-way (bivariate) association between transportation mode (nominal) and cost (continuous). Simple bar chart, with one bar for each transportation mode on the *x* axis and cost on the *y* axis.
   c. Composition (univariate) of a nominal variable. Pie chart to illustrate the percentage (or number of cases) from rural, suburban, and urban areas.
   d. Distribution of one categorical variable (educational attainment) within another categorical variable (continent). Stacked bar chart, with bars for U.S. native-born people and each continent of origin, and one slice for each educational attainment level. Each bar totals 100% of that continent's immigrants (on the *y* axis) to illustrate composition while correcting for different numbers of immigrants across continents.
   e. Association between several nominal independent variables (gender, occupation, and region) and a continuous dependent variable (relative odds of being laid off in the past year). High/low/close chart ("high" and "low" show the upper and lower 95% confidence limits), with the independent variables on the *x* axis and the odds ratios on the *y* axis.
   f. Association between a continuous independent variable (percentage body fat) and a continuous dependent variable (systolic blood pressure). Single-line chart with the percentage body fat on the *x* axis and blood pressure on the *y* axis, each labeled with its respective units.
   g. Net effects of an interaction between two categorical independent variables (tercile of student's class rank and mother's educational attainment) and a continuous independent variable (first-year college GPA). Clustered bar chart with one cluster for each category of mother's education on the *x* axis and a different bar color for each tercile of class rank (in the legend). *Y* axis shows predicted mean first-

year college GPA. Notes specifying data source and other variables controlled in the model (or naming a table in which those estimates are shown), identifying the reference categories for class rank and mother's education, and defining symbols used to denote statistical significance.

5. Create a stacked bar chart, after answering the given questions.
   a. Counties arranged on the *x* axis in descending order of total number of unhealthy ozone days
   b. A different color slice for each level of ozone warning, identified in the legend
   c. Number of unhealthy ozone days goes on the *y* axis
   d. Same title as table 6A: "Number of unhealthy ozone days by level of warning for selected counties in Indiana, 1996–1998"

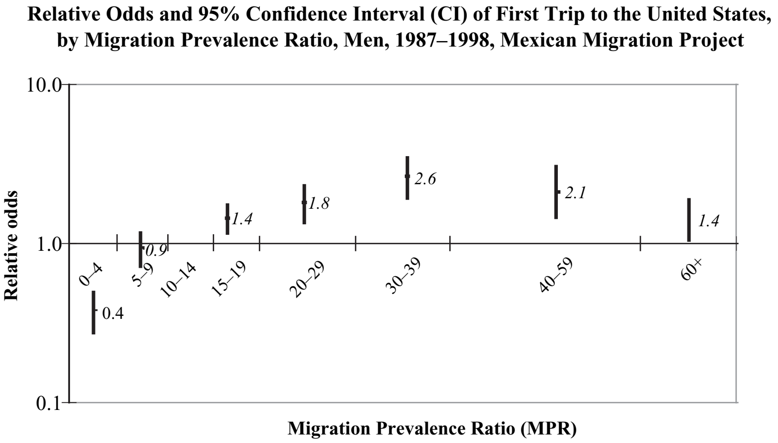
7. Create charts showing the specified patterns from analysis by Fussell and Massey (2004).
   a. Chart to portray the association between age in years and relative odds of first trip to the United States, compared to 15-year-olds.



Based on model controlling for marital status, number of children, education, labor force experience, family migrant history, and migration prevalence ratio. Reference category = 15 year olds.

Figure 6C.

b. Chart to portray the association between the migration prevalence ratio and relative odds of first trip to the United States, with 95% confidence intervals.



Compared to MPR = 10-14. Based on model controlling for age, marital status, number of children, education, labor force experience, and family migrant history.

Figure 6D.

Comments: A logarithmic scale was used to preserve symmetry in apparent sizes of odds ratios above and below 1.0; see "Charts to Display Logistic Regression Results" on page 157 of *Writing about Multivariate Analysis* for an explanation. Spacing of categories on *x* axis is proportional to actual width of the Migration Prevalence Ratio (MPR) categories: 5-year-wide MPR categories (e.g., 0–4, 15–19) appear half as wide as 10-year-wide MPR categories (e.g., 30–39), which are half as wide as the 20-year-wide MPR category (40–59).

9. Create charts to accompany the specified GEE descriptions of results from Mensch et al. (2003).

   a. Chart presenting odds ratios of reporting a sensitive behavior by mode of interview among boys.

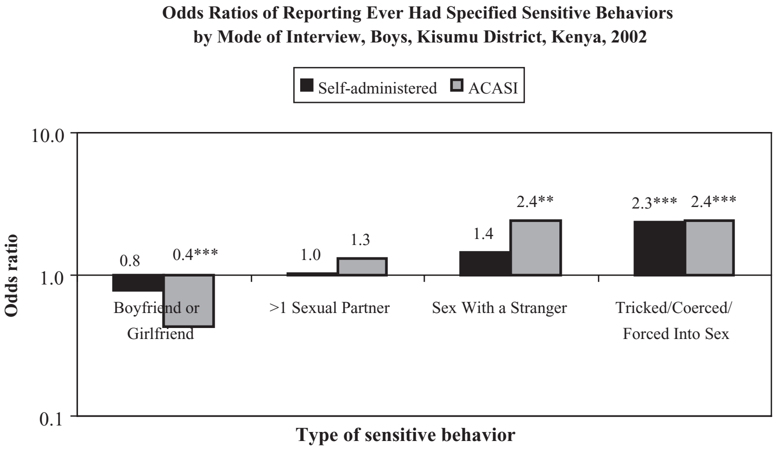
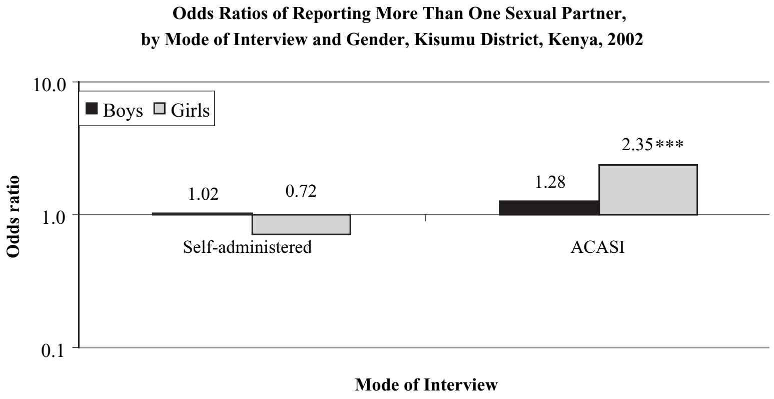


Figure 6E.

b. Chart of the association between mode of interview and odds ratios of reporting having had more than one sexual partner by gender.



ACASI = audio computer-assisted self-interviewing. Reference category = Interviewer administered.
Compared to children of the same gender.
* p < 0.05; ** p < 0.01; *** p < 0.001.

Figure 6F.

Comments: A logarithmic *y* scale was used on figures 6E and 6F to preserve symmetry in apparent sizes of odds ratios above and below 1.0.

7

Choosing Effective Examples and Analogies

PROBLEM SET

1. For each of the following topics, give an analogy to suit a general audience.
   a. A 12-inch snowfall
   b. Two numbers at opposite ends of a distribution
   c. An erratic pattern of change
   d. Something moving rapidly
   e. A few things
   f. Something very heavy
   g. Prices that are rising rapidly
   h. Something that has been level for a long time and then declines suddenly and substantially
   i. A repetitive pattern

2. Repeat the previous question but for a scientific audience in your field.

3. Devise short phrases to convey the concept of small size to the people listed below.
   a. A cooking aficionado
   b. A gardening nut
   c. An artist
   d. A sports fanatic

4. Each of the following analogies would work better for some audiences than others. Name a suitable audience, an unsuitable audience, and an improved analogy for the latter group.
   a. "The size of a Palm Pilot"
   b. "The gasoline shortage of the early 1970s"

5. For each of the following topics, state whether information from Illinois in 1990 would be useful as a numeric example. If so, give an example of a type of contrast in which that information could be used.
   a. Chicago in 1990
   b. Illinois in 2000
   c. Illinois schoolchildren in 1990
   d. Iowa voters in 2004

6. Your state is considering three alternative income tax scenarios: a stable tax rate (at 5%), an increase of 0.5 percentage points, and an increase of 1.0 percentage points. Your local representative wants to know how each scenario would affect low-, moderate-, and high-income residents.
   a. What criteria could you use to define “low,” “moderate,” and “high” income?
   b. What kinds of numeric contrasts would you use to compare the different scenarios?
   c. Create a table to present those effects to the government budget agency.
   d. Create a chart to illustrate the effects to citizens of the state.

7. State whether a one-unit increase would be a useful contrast for each of the following topics. If not, suggest a more reasonable increment.
   a. Annual income (in dollars) for a family of four in the United States in 2004
   b. A Likert scale measuring extent of agreement with a gun control law
   c. Cholesterol level in milligrams per deciliter (mg/dL)
   d. Proportionate increase in the unemployment rate
   e. Hourly minimum wage (in dollars) in the United States in 2004

8. Zimmerman (2003) reports that the mean combined (verbal + math) SAT score for Williams College students in the classes of 1990–2001 was 1,396 points, with a standard deviation of 123. He estimates an OLS regression model of college GPA, with combined SAT score as an independent variable. Select a pair of plausible values to use as inputs for an illustration of effect size. (See problem set to chapter 9 for full citation.)

7

Choosing Effective Examples and Analogies

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. In a journal article in your field,
   a. Circle all analogies or metaphors used to illustrate quantitative patterns or relationships.
      i. Does the author explicitly or implicitly convey the purpose of each analogy or metaphor, or is it left unclear?
      ii. Is it easy to understand the analogy and the pattern or relationship it is intended to illustrate?
   b. Choose one unclear analogy from the paper and revise it, using the principles in chapter 7 of *Writing about Multivariate Analysis*.
   c. Are there other places in the article where an analogy or metaphor would be helpful? Identify the purpose of the analogy or metaphor for each such situation.
   d. Design an analogy or metaphor to suit one instance where you have suggested adding one (from part c), using the principles in chapter 7.
   e. Identify the intended audience for the article. Choose a different audience (e.g., more quantitatively sophisticated; younger) and rewrite one analogy to suit them.

2. In the same article, circle all numeric examples where a single number is reported (e.g., not a comparison of two or more numbers). For each, indicate whether the author conveys the purpose of the example (e.g., whether it is a typical or unusual value).

3. In the same article, circle all numeric contrasts.
   a. Indicate whether in each instance the author provides enough information for you to assess whether it is a realistic difference or change for the research question and context.
   b. Evaluate whether different or additional size contrasts would be useful for the intended audience, considering
      i. plausibility;
      ii. real-world application;
      iii. measurement issues.
   c. Identify an audience that would be interested in different applications than the audience for whom the article is currently written. Describe how you would select numeric contrasts to meet their interests.

B. APPLYING STATISTICS

1. Calculate and graph the frequency distribution of a continuous independent variable using the highest possible level of detail (e.g., the smallest units for that variable available in your data).
   a. Name the shape of the distribution (e.g., normal, uniform, skewed).
   b. Mark the cutpoints for the quartiles of that variable on the chart.
   c. Mark ± 1 standard deviation (SD) and ± 2 SD on the chart.
   d. Evaluate whether there is appreciable heaping in the reported values of that variable.
   e. Explain the criteria you will use to select appropriate values to contrast within your data as you illustrate model findings in your results section. In other words, what are plausible changes or differences in your data, given its distribution? Refer to your answers to parts a through d of this question.

2. For a continuous dependent variable in your data set, review the literature in your field to determine whether standards or cutoffs are commonly used to classify that variable. If so, calculate and describe a contrast between your data and that standard or cutoff.

3. Graph the relationship between the dependent variable you used in question B.1 and a continuous independent variable.
   a. If you wanted to use a categorical version of that independent variable in your model, what does the graph suggest might be empirically appropriate cutpoints between categories? Why?
   b. Read the literature on the relationship between that independent variable and your dependent variable. Are there standard ways to classify the independent variable?
   c. Are there policy criteria, program criteria, or other practical criteria related to your research question that suggest ways you might classify that variable? (Examples include multiples of the Federal Poverty Level related to social program eligibility, and clinically recommended ranges of blood pressure. Find criteria related to your topic.)
   d. Do the empirical cutoffs you identified in part a match the cutoffs you found for parts b and c? If not, explain which of these criteria you will use to classify your data and why they suit your intended audience.
   e. Design a table or chart to contrast results obtained using the approaches to classifying your independent variable in parts a through c.

C. WRITING AND REVISING

1. For each of the following audiences, devise an analogy to describe one of the main numeric patterns or relationships in the results section of your paper, using the criteria in chapter 7 of *Writing about Multivariate Analysis*.
   a. Readers of a leading journal in your field
   b. Undergraduate students in an intermediate-level substantive course in your field
   c. Readers of the popular press, assuming an eighth-grade reading level

d. Exchange your answers to parts a through c with someone studying writing about a different topic or data. Peer-edit the work.

2. Critique a paper you have written previously using the guidelines in questions A.1 through A.3.

7

Choosing Effective Examples and Analogies

SOLUTIONS

1. Provide analogies for the given topics.
   a. "Knee deep"
   b. "Polar opposites"
   c. "All over the map"
   d. "Faster than a speeding bullet"
   e. "A handful"
   f. "As heavy as an elephant"
   g. "Going through the roof"
   h. "Like it fell off a cliff"
   i. "Like a broken record"

3. Devise short phrases conveying the concept of small size to the given audience.
   a. "Pea-sized"
   b. "Like a grain of sand or a seed"
   c. "Like a speck of paint"
   d. "Like a drop of water in an Olympic-sized swimming pool"

5. Consider whether information from Illinois in 1990 would be useful for the specified comparison.
   a. Useful for a comparison of the state and its largest city in the same year
   b. Useful for analysis of trends over time in the entire state
   c. Useful for comparison of one age group to the total population
   d. A poor choice, as too many dimensions differ (time, place, and age)

7. State whether a one-unit increase is a useful contrast for the specified topics and if not, give alternatives.
   a. Too low to be of substantive interest. Use increments of $1,000 instead.
   b. Reasonable.
   c. Too low to be clinically meaningful or measured precisely. Use an increment of 10 mg/dL.
   d. Too high. An increase of one unit would span the entire theoretically possible range. Use an increase of 0.05 or 0.10.
   e. Reasonable.

8

Basic Types of Quantitative Comparisons

PROBLEM SET

1. Identify the type of quantitative comparison used in each of the following statements:
   a. "Yesterday, New York City received 5.5 inches of snow."
   b. "Ian Thorpe's margin of victory in the 400-meter freestyle was 0.74 seconds."
   c. "A 30-year-old man has 0.59 times the odds of migrating as a 20-year-old man."
   d. "The Dow Jones Industrial Average dropped 0.6% since this morning's opening."
   e. "Women's GPAs are on average 0.26 points higher than men's GPAs."
   f. "Cornstarch has twice the thickening power of flour; for each teaspoon of flour called for in a recipe, substitute one half teaspoon of cornstarch."
   g. "Median income for the metro region was $31,750."
   h. "Among males, self-esteem averages nearly half a standard deviation unit lower among widowers than among nonwidowers."
   i. "Sixty-eight percent of registered voters turned out for the primary election."
   j. "State U was seeded first in the tournament."

2. In the 2000 presidential election, Al Gore received 50,996,116 votes while George W. Bush received 50,456,169 votes.
   a. Write a sentence to describe the ranks of the two candidates.
   b. Calculate the absolute difference between the numbers of votes each candidate received. What impression does that information alone convey?
   c. Calculate the percentage difference between the numbers of votes each candidate received. What impression does that information give?

3. Indicate whether each of the following statements is correct. If not, rewrite the second part of the sentence to agree with the first.
   a. "Brand X lasts longer than Brand T, with an average lifetime 40% as high as Brand T's."
   b. "The unemployment rate increased 25% since last year, from 4.0% to 5.0%."
   c. "The ratio of flour to butter in shortbread is 2 : 1; the recipe uses twice as much butter as flour."
   d. "At this time of year, reservoirs are usually 90% full. Currently, with reservoirs at 49% of capacity, water levels are only about 54% of normal."

e. "Nadia's test score was higher than 68% of students nationwide ($Z = 1.0$)."
f. "A panel of 200 consumers rated ISP A four to one over ISP B. In other words, four more panelists preferred Company A as their Internet service provider."
g. "Matt is in the top decile for height. He is among the tallest 10% of boys his age."
h. "The coefficient dropped 15% between the unadjusted and adjusted models, decreasing from 2.0 to 1.7."
i. "The value of mutual fund ABCD tripled since last year, going from 100 to 33."

4. In the 1999 Diallo case in New York City, 41 bullets hit the victim. Write down the criteria that you would intuitively use to interpret that number: against what are you comparing the number of bullets?

5. Each of the following statements correctly describes part of table 8A, but each description is incomplete. Fill in the missing information.

Table 8A. Median income by race and Hispanic origin, United States, 1999

Race/Hispanic origin	Median income
White	$42,504
Black	$27,910
Asian/Pacific Islander	$51,205
Hispanic (can be of any race)	$30,735

Source: U.S. Bureau of the Census, *Statistical Abstract of the United States,* 2001, table 662.

a. "Asians make about twice as much income."
b. "Hispanics earn $2,825 more."
c. "Whites rank second."
d. "The percentage difference for Asians was 20%."

6. Use table 8B to perform the tasks listed below.

Table 8B. Price per gallon for regular unleaded gasoline at selected gas stations, June 2000 and June 2001

Gas station	June 2000	June 2001
AAA	$1.45	$1.71
Bosco	$1.37	$1.75
Cargo	$1.48	$1.68
Dart	$1.30	$1.66
Essow	$1.46	$1.74

a. Rank the stations from highest to lowest gas price for each of the two dates.

b. Write a description of the distribution of prices in each year. Use absolute and relative difference in your description to convey the differences between the two distributions.

c. Describe how you might use rank in conjunction with absolute or relative difference in deciding where to buy gas.

7. For each of the phrases listed below, identify other phrases on the list that have the same meaning; write the equivalent dollar value, assuming comparison against a price of $200; and write the corresponding ratio. For statement a, for example, the equivalent dollar value would be $50 and the corresponding ratio would be 0.25.
   a. "25% of the original price"
   b. "costs 25% less than . . . "
   c. "costs 25% more than . . . "
   d. "priced 25% off"
   e. "125% of the original price"
   f. "marked down 75%"
   g. "75% of the original price"
   h. "costs 75% as much as . . . "

8. The homicide rate in Texas dropped from 16 homicides per 100,000 persons in 1990 to 10 per 100,000 in 1995. Calculate and write sentences to describe
   a. the absolute differences between the homicide rates in the two periods;
   b. the relative differences between the homicide rates in the two periods;
   c. the percentage change between the two periods using
      i. the 1990 rate as the denominator;
      ii. the average of the two rates as the denominator.

9. In table 8C, fill in the *z*-score for height for each boy in the sample.

Table 8C. Heights of a sample of six-year-old boys (standard population: mean = 115.12 cm; SD = 4.78 cm)

Name	Height (cm)	*Z*-score
David	117.51	
Jamal	113.90	
Ryan	124.81	
Luis	115.45	
JC	112.73	

SD = standard deviation

a. Describe how Ryan's, Luis's, and JC's heights compare to the national norms for boys their age based on their *z*-scores. (See table 8.3 in *Writing about Multivariate Analysis,* 194, for ways to avoid using the phrase "*z*-scores" as you write).

b. Two boys have heights about equidistant from the mean—one above and one below average. Who are they and about how far are their heights from those of average six-year-old boys? Report the difference in terms of standard deviation units.

c. A new boy, Mike, joins the class. He is one standard deviation taller than the average six-year-old boy. How tall is Mike?

10. One thousand people lived in Peopleland in 2000 and the population was growing at an annual rate (*r*) of 2.0% per year.

Table 8D. Population of Peopleland, 2000–2010

Year	Population	Absolute increase from previous year	Cumulative increase since 2000	Percentage change since 2000
2000	1,000			
2001				
2002				
2003				
2004				
2005				
2006				
2007				
2008				
2009				
2010				

a. Use the formula $P_t = P_0 \times e^{rt}$ to fill the population for each year into table 8D. The year 2000 is year 0, *t* is the number of years since 2000, *r* (the annual growth rate, expressed as a proportion) is 0.02, and *e* is the base of the natural logarithms (2.718).

b. Calculate the absolute increase in population from the preceding year. Write a sentence explaining the pattern of absolute population increase across the 10-year period.

c. The cumulative increase is the total number of people added to the population since 2000. How many more people live in Peopleland in 2010 than in 2000?

d. Calculate the percentage change relative to 2000 for each year. Write a sentence to describe the percentage change in population between 2000 and 2010.

e. What is the ratio of the population size for 2010 compared to 2000? How does that ratio relate to the percentage change over that 10-year period?

f. How do the annual rate of growth and the percentage change between 2000 and 2010 relate?

11. Suppose the adjusted odds ratio of hospital admission for diabetics compared to nondiabetics is 3.5.

a. If 5% of the population is diabetic, calculate the attributable risk of hospital admission associated with diabetes.

b. Write a sentence explaining that result without using the term "attributable risk."

8

Basic Types of Quantitative Comparisons

SUGGESTED COURSE EXTENSIONS

■ A. REVIEWING

1. Find a report about recent patterns in mortality, fertility (National Center for Health Statistics Web site), or unemployment (Bureau of Labor Statistics Web site).
   a. Identify an example of each of the following: rank, absolute difference, relative difference, and percentage difference or change.
   b. For each example, identify the reference value. Does it come from within their data or some other source (e.g., a historic value or a reference population)?
   c. Read the explanations of those examples. Is each one clear? If not, use the criteria outlined in chapter 8 of *Writing about Multivariate Analysis* to improve the explanation.
   d. Identify at least one instance where a different (or additional) comparison would be useful. Perform the calculations and write a sentence to present the results.

2. Find a journal article about an application of a multivariate model.
   a. Identify which kinds of basic quantitative comparisons are used to contrast and interpret numeric findings.
   b. Repeat questions A.1b through A.1d for the quantitative comparisons in that article.

■ B. APPLYING STATISTICS

1. For a continuous independent variable from your data set
   a. Identify a pair of values to contrast.
   b. Choose two ways to compare the numbers. Explain your choice of types of quantitative comparisons, with reference to common usage in your field.
   c. Calculate the pertinent comparisons.
   d. Write a paragraph to explain the results of your calculations from part c.
   e. Use the checklist at the end of chapter 8 in *Writing about Multivariate Analysis* to evaluate completeness and clarity of your explanation.

2. List all of the categorical variables used in your multivariate model, either as a dependent or independent variable. For each,
   a. Identify the modal value.
   b. Read the literature to see which value of that variable is most commonly used as the reference category.
   c. Consider the role of that variable in your research question and whether that affects your choice of a reference category.
   d. Cross-tabulate the independent variables to identify the modal categories of the variables in bivariate combination with one another.
   e. Using the information in parts a through d and the criteria on pages 186–87 of *Writing about Multivariate Analysis,* specify which category you will use as the reference category and explain the basis for your choice.

3. Calculate attributable risk for a risk factor and outcome in your data.
   a. Use logistic regression to estimate the relative odds (odds ratio) of a categorical dependent variable for a dichotomous risk factor (independent variable).
   b. In conjunction with information on the prevalence of that risk factor, calculate the attributable risk.
   c. Write a sentence interpreting the results of the attributable risk calculation with reference to the specific variables involved.

■ C. WRITING AND REVISING

1. Identify a numeric background fact to compare with information for other time periods or cases as part of the introductory section of a research paper.
   a. Select two pertinent types of quantitative comparisons for that fact. Explain your choice, with reference to the topic of your paper.
   b. Look up the relevant data, and calculate the comparisons.
   c. Write a paragraph that integrates those quantitative comparisons, including citations.
   d. Use the checklist at the end of chapter 8 of *Writing about Multivariate Analysis* to evaluate the completeness and clarity of your description.

2. Repeat question B.1 for the results section of your paper.

8

Basic Types of Quantitative Comparisons

SOLUTIONS

1. Identify the type of quantitative comparison in the given statements.
   a. Value
   b. Absolute difference
   c. Ratio (relative difference)
   d. Percentage change
   e. Absolute difference
   f. Ratio (relative difference)
   g. Rank (median is the 50th percentile)
   h. *Z*-score (standardized value)
   i. Value (in this case, the units of measurement are percentage points)
   j. Rank

3. Identify the correct statements; rewrite the incorrect statements to correct them.
   a. "Brand X lasts longer than Brand T, with an average lifetime 40% higher than Brand T's."
   b. Correct as written.
   c. "The ratio of flour to butter in shortbread is 2 : 1; the recipe uses twice as much flour as butter."
   d. Correct as written.
   e. "Nadia's test score was higher than 84% of students nationwide ($Z = 1.0$)." (Sixty-six percent are within 1 standard deviation of the mean [e.g., ± 1 standard deviation], but you must also include those for which $z < -1.0$ to answer this question correctly.)
   f. "A panel of 200 consumers rated ISP A four to one over ISP B. In other words, four times as many panelists preferred Company A as their Internet service provider."
   g. Correct as written.
   h. Correct as written.
   i. "The value of mutual fund ABCD tripled since last year, going from 33 to 100."

5. Fill in the missing information.
   a. "Asians make about twice as much income as blacks."
   b. "Hispanics earn $2,825 more than blacks."
   c. "Whites rank second in terms of median income, below only Asians and Pacific Islanders."
   d. "Asians earn 20% more than whites."

7. With a comparison value of $200:

   The two phrases "25% of the original price" (item a) and "marked down 75%" (f) have the same meaning. Each of those phrases corresponds to a price of $50, equivalent to a ratio of 0.25.

   The phrases "costs 25% less than . . . " (item b), "priced 25% off" (d), "75% of the original price" (g), and "costs 75% as much as . . . " (h) are equivalent. They correspond to a price of $150, equivalent to a ratio of 0.75.

   The two phrases "costs 25% more than . . . " (item c) and "125% of the original price" (e) have the same meaning. They correspond to a price of $250 and a ratio of 1.25.

9. Fill in the *z*-score for height for each boy in the sample.

Table 8C. Heights of a sample of six-year-old boys (standard population: mean = 115.12 cm; SD = 4.78 cm)

Name	Height (cm)	*Z*-score
David	117.51	0.50
Jamal	113.90	–0.26
Ryan	124.81	2.03
Luis	115.45	0.07
JC	112.73	–0.50

SD = standard deviation

   a. Ryan is approximately two standard deviations above the average height for a six-year-old boy, while Luis is just about average and JC is half a standard deviation below average for his age.
   b. David and JC are half a standard deviation taller and shorter than the average six-year-old boy, respectively.
   c. Mike stands 119.90 cm tall.

11. Answer the questions about attributable risk from the information given.
   a. The attributable risk of hospital admission associated with diabetes is calculated: $[0.05(3.5 - 1)]/[(0.05[3.5 - 1]) + 1] \times 100 = 11.1\%$. Prevalence is expressed as a proportion in the calculation.
   b. If diabetes could be eliminated, hospital admissions would decline by 11%.

9

Quantitative Comparisons for Multivariate Models

PROBLEM SET

1. Indicate whether each of the following statements is correct. If not, rewrite the second part of the sentence to agree with the first.
   a. "The odds ratio of passing the test was 0.60 for students in School A compared to School B, meaning that students in School A were 60% more likely to pass than those in School B."
   b. "Log-odds of migration for men whose siblings had migrated were 0.51, reflecting higher chances of migration for them than for men whose siblings had not migrated."
   c. "Relative odds of migration for ever-married men were 0.91, reflecting higher chances of migration for ever-married than never-married men."
   d. "The standardized beta for widows was −0.5, meaning that widows scored on average half a point lower than nonwidows."
   e. "The relative risk of divorce for teens compared to older adults was 2.50, corresponding to an excess risk of 150% for teens."
   f. "The relative risk dropped from 2.50 to 2.00 between the unadjusted and adjusted models, corresponding to a 50% reduction in excess risk."

2. For each of the following research questions, indicate whether you would specify an OLS model or a logit model, and identify the units or omitted category of the dependent variable.
   a. Whether income is associated with chances of being arrested.
   b. Whether a new medication decreases average cholesterol levels.
   c. Whether child's IQ varies by parents' IQs.
   d. Whether cohabitation prior to marriage is associated with risk of divorce.

Table 9A. Regression of cumulative grade point average by own SAT scores and roommate's SAT scores, Williams College classes of 1999–2001

	Coeff. (s.e.)
Own verbal SAT score/100	0.195 (0.011)
Own math SAT score/100	0.092 (0.011)
Race (ref. = white)	
Black	–0.264 (0.033)
Hispanic	–0.160 (0.035)
Native American	0.098 (0.175)
Not a U.S. citizen	0.099 (0.043)
Asian	–0.085 (0.022)
Female	0.128 (0.013)
Roommate's verbal SAT score/100	0.027 (0.010)
Roommate's math SAT score/100	–0.016 (0.010)
Sample size	3,151
R^2	0.378

Source: Adapted from David A. Zimmerman, "Peer Effects in Academic Outcomes: Evidence from a Natural Experiment," *Review of Economics and Statistics* 85.1 (2003): 9–23, table 3. Also available to subscribers at *http://weblinks2.epnet.com*.

In a 2003 article in the journal *Review of Economics and Statistics,* Zimmerman uses data from Williams College on individual students' grades, their SAT scores, and their roommates' SAT scores to estimate models of peer effects on academic performance (table 9A). Use that information to answer questions 3 through 7 below.

3. For the model shown in table 9A,
   a. Identify the dependent variable, the type of variable (continuous or categorical), its units or coding, and theoretically possible range.
   b. State whether an OLS model or logit model is more suitable for this analysis.

c. Identify the continuous independent variables, their units as specified in the model, and their theoretically possible ranges.

d. Identify the categorical independent variables and their reference categories.

4. What is the estimated difference between male and female GPAs? Is that difference statistically significant?

5. What is the difference in predicted GPAs if a student's own verbal SAT score was 720 instead of 680? (Assume the student is in the reference category for all other variables in the model.)

6. What is the difference in predicted GPAs if a student's roommate's math SAT score was 720 instead of 680? (Assume the student is in the reference category for all other variables in the model.)

7. If the intercept term is 0.780, what would the predicted GPA be for a white male student with a verbal SAT of 720, a math SAT of 700, and a roommate with a verbal SAT of 680 and a math SAT of 650? (Actual intercept terms could not be reported due to confidentiality of students' information.)

Using data from the 1979 National Longitudinal Survey of Youth, Light (2004) analyzes gender differences in effects of marriage and cohabitation on change in total family income (table 9B). Answer questions 8 and 9 using that information.

Table 9B. Estimated effect of marital-status transitions on total family income, United States, 1979–2000

Gender and type of marital status transition	Coefficient	Standard error
Women		
Single to cohabiting	0.440	0.027
Single to married	0.416	0.026
Men		
Single to cohabiting	–0.011	0.026
Single to married	–0.035	0.025
Women and Men		
Cohabiting to married	–0.013	0.019

Source: Adapted from "Difference Model 2," table 3, from Audrey Light, "Gender Differences in the Marriage and Cohabitation Income Premium," *Demography* 41.2 (2004): 263–84, *http://muse.jhu.edu/journals/demography/v041/41.2light.pdf*.

Notes: N = 4,700 women and 5,139 men. Dependent variable = log(posttransition income) – log(pretransition income).

8. Perform these tasks using the information in table 9B.

a. Write a sentence identifying the dependent variable in the model without using an equation.

b. Calculate the value of the dependent variable corresponding to an increase in income from $20,000 to $35,000.

9. Write sentences to present the effects of the following transitions, using the information in table 9B.
   a. The effect of a woman transitioning from single to married on change in log(family income).
   b. The effect of a woman transitioning from single to married, in terms of percentage change in family income.
   c. The effect of a man transitioning from single to married, in terms of percentage change in family income.
   d. The effect of a woman transitioning from single to married on family income in dollars, assuming that she had an income of $20,000 when she was single.

Fussell and Massey (2004) used data from the Mexican Migration Project to study relationships among demographic factors, human capital, social capital in the family and community, and migration from Mexico to the United States (table 9C). Use the information in table 9C to answer questions 10 through 13.

Table 9C. Estimated log-odds of first trip to the United States, Men, 1987–1998 Mexican Migration Project

	Log-odds	Standard error
Demographic background		
Age (years)	–0.003	0.02
Age-squared	–0.001	0.0002
Ever married	–0.09	0.06
Number of minor children in household	0.01	0.01
Human capital		
Years of education	–0.04	0.006
Months of labor-force experience	–0.002	0.0007
Social capital in the family		
Parent a prior U.S. migrant	0.51	0.05
Siblings prior U.S. migrants	0.36	0.02
Social capital in the community		
Migration prevalence ratio[a]		
0–4	–0.99	0.15
5–9	–0.09	0.12
(10–14)		
15–19	0.35	0.10
20–29	0.57	0.13
30–39	0.95	0.15
40–59	0.74	0.19
60 or more	0.34	0.15
Intercept	–3.31	0.26
– 2 log likelihood	23,369.2	
Df	26	

Source: Adapted from Elizabeth Fussell and Douglas S. Massey, “The Limits to Cumulative Causation: International Migration from Mexican Urban Areas,” *Demography* 41.1 (2004): 151–71. Table 2, http://muse.jhu.edu/journals/demography/v041/41.1fussell.pdf.

Note: Model also includes controls for occupational sector, internal migratory experience, community characteristics, and Mexican economic and U.S. policy context.

[a] The migration prevalence ratio = (the number of people aged 15+ years who had ever been to the U.S./the number of people aged 15+ years) ×100.

10. Perform these tasks using the information in table 9C.
    a. Identify the dependent variable, the type of variable (continuous or categorical), its units or coding, and theoretically possible range.
    b. State whether an OLS model or logit model is more suitable for this analysis.
    c. Identify the continuous independent variables, their units as specified in the model, and their theoretically possible ranges.
    d. Identify the categorical independent variables and their reference categories.

11. Assuming all other variables are in the reference category or at their mean values, calculate the relative odds of first migration to the United States for
    a. an ever-married man compared to a never-married man
    b. a 30-year-old man compared to a 20-year-old man
    c. a man with a parent who is a prior U.S. migrant compared to a man without parents who migrated there
    d. a man from a community with a migration prevalence ratio (MPR) of 0–4 compared to one from a community with an MPR of 10–14
    e. a man from a community with a migration prevalence ratio (MPR) of 0–4 compared to one from a community with an MPR of 60 or more

12. Create a table contrasting odds of first trip to the United States at 10-year age intervals from 15 through 64 years; specify the values of the other variables you used in your calculations.

13. Calculate the odds of first migration for a 20-year-old never-married man with no children, eight years of education, 24 months of labor force participation, neither parents nor sibling prior migrants, from a community with an MPR of 10–14.

Table 9D summarizes results of Carr's (2004) analysis of relations among dependence on a spouse, gender, and psychological adjustment to the death of a spouse. Answer questions 14 and 15 using that information.

Table 9D. OLS regressions of self-esteem at wave 2, overall and by gender, changing lives of older couples (cloc) study, 1987–1994

	Total sample		Women		Men	
Variable	Coeff.	Std. error	Coeff.	Std. error	Coeff.	Std. error
Widow	–0.51*	0.24	0.25†	0.15	1.67	1.22
Female	–0.60**	0.22				
Interaction: female × widow	0.70**	0.26				
Emotional dependence on spouse			–0.35**	0.13		
Interaction: emotional dependence on spouse × widow			0.34**	0.15		
Dependence on spouse for homemaking tasks					2.67*	1.35
Interaction: dependence on spouse for home making tasks × widow					–2.92*	1.39
Dependence on spouse for home maintenance and financial tasks					–1.30*	0.55
Interaction: dependence on spouse for home maintenance and financial tasks × widow					1.58**	0.59
Intercept	2.13	0.76*	0.54	0.79	1.75	2.12
R^2 adjusted	0.19		.024		0.19	
Unweighted *N*	297		217		80	

Source: Adapted from Deborah Carr, "Gender, Preloss Marital Dependence, and Older Adults' Adjustment to Widowhood," *Journal of Marriage and the Family* 66 (2004): 220–35, table 2. Models also control for wave 1 well-being, demographic characteristics, and number of months between wave 1 and 2 interviews. Dependence measures assessed at wave 1.

* $p < 0.05$. ** $p < 0.01$. † $p < 0.10$.

14. Using the results for women in table 9D:
    a. Create a spreadsheet to calculate the net effect of the interaction between emotional dependence on spouse, widowhood status, and predicted self-esteem, using the guidelines in appendix D of *Writing about Multivariate Analysis*. Both self-esteem and emotional dependence are in standardized units (mean = 0, standard deviation [SD] = 1). Allow emotional dependence to vary from −1.0 to 1.0 SD in your calculations.
    b. Design a chart to portray this pattern.
    c. Write a short description of the association between emotional dependence on spouse, widowhood status, and predicted self-esteem using the GEE approach.
    d. Explain why there isn't a dummy variable for "female" in the stratified models.

15. Using the results for the total sample in table 9D:
    a. Create a table to show predicted self-esteem for each of the four possible combinations of gender and widowhood status.
    b. Create a chart to portray that association.
    c. Write a short description of the association between gender, widowhood status, and predicted self-esteem using the GEE approach.

16. Suppose a study found that the unadjusted odds ratio of hospital admission for diabetics compared to nondiabetics is 3.50.
    a. Calculate the excess risk of hospital admission for diabetics.
    b. When demographic factors and other health conditions are taken into account, the adjusted odds ratio for diabetics is 3.00. Calculate the change in excess risk of hospital admission for diabetics between the adjusted and unadjusted models.

17. Suppose a study found that 20% of nondiabetics were admitted to the hospital.
    a. Using the adjusted odds ratio from the previous question, calculate the corresponding relative risk of hospital admission for diabetics.
    b. Express the discrepancy between the odds ratio and the relative risk as a percentage difference.
    c. Write a sentence describing the association between diabetes and hospital admission, using the criteria under "An Aside on Relative Risk and Relative Odds " on pages 224–226 of *Writing about Multivariate Analysis*.

9

Quantitative Comparisons for Multivariate Models

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. Find a journal article in your field that presents results of an OLS model with at least one categorical independent variable and at least one continuous independent variable. Use the results to answer the following questions.
   a. Critique the description of the coefficient on a continuous independent variable in terms of direction, magnitude, statistical significance, and units, using the criteria in chapter 9 of *Writing about Multivariate Analysis*.
   b. Critique the description of the coefficient on a categorical independent variable using the criteria in chapter 9.
   c. Rewrite the descriptions of both coefficients to correct any problems you identified in parts a and b of this question.

2. Find a journal article that presents results of an OLS model with an interaction between a categorical independent variable and a continuous independent variable.
   a. Do the authors calculate and present the net effect of the interaction? If so, how? If not, suggest an appropriate tool for presenting the results for this research question and audience.
   b. Critique the authors' written description of the interaction using the criteria in chapters 9 and 13 of *Writing about Multivariate Analysis*.
   c. Rewrite the description of the interaction to correct any shortcomings you identified in parts a and b of this question.

3. Find a journal article that presents results of an OLS model with an interaction between two categorical independent variables.
   a. Do the authors calculate and present the net effect of the interaction? If so, how? If not, suggest an appropriate tool for presenting those results for this research question and audience.
   b. Critique the description of that interaction using the criteria in chapters 9 and 13.
   c. Rewrite the description of the interaction to correct any shortcomings you identified in parts a and b.

4. Find a journal article that presents results of an OLS model with standardized coefficients.
   a. Critique the description of the coefficient for one variable, using the criteria in chapter 9.

b. Rewrite the description to correct any shortcomings you identified in part a.

5. Find a journal article that presents results of an OLS model with a lin-log or log-lin specification.
   a. Critique the description of results, including correct interpretation and units of effect size, using the criteria in chapter 9.
   b. Rewrite the description to correct any shortcomings you identified in part a.

6. Find a journal article that presents results of a logistic regression of a binary dependent variable, with at least one categorical independent variable and at least one continuous independent variable. Use the results to answer the following questions.
   a. Do they report log-odds or odds ratios? If odds ratios, do they interpret them in terms of multiples of odds or multiples of risk?
   b. Critique the description of the effect size for a continuous independent variable in terms of direction, magnitude, statistical significance, and units, using the criteria in chapter 9.
   c. Critique the description of the effect size for a categorical independent variable.
   d. Rewrite the descriptions to correct any shortcomings you identified in parts b and c.

■ B. APPLYING STATISTICS AND WRITING

Notes: For the "applying statistics" questions, use variables from your own data to substitute for Y_1, Y_2, X_1, *DUMMY,* and *CATEGVAR* in the models described below. For example, suppose you want to examine factors that predict income. You might use income in dollars as a continuous dependent variable (Y_1), educational attainment in years as a continuous independent variable (X_1), gender as a binary independent variable (*DUMMY*), and residence (urban/suburban/rural) as a multicategory independent variable (*CATEGVAR).* If you wanted to study factors that predict poverty, you might use poverty status (poor/nonpoor) as a categorical dependent variable (Y_2), with the same set of independent variables.

If possible, choose variables that are part of an ongoing research project. Save the computer output from the models you estimate in questions B.1 through B.6 for use in the exercises for chapter 10.

1. Using data on a continuous dependent variable (denoted Y_1 in the equations below) and a continuous independent variable (denoted X_1 in the equations below), estimate the following variants of an OLS model. For each, write a sentence interpreting the value of β_1, referring to the variables you have used and specifying the units using the guidelines in chapter 9 of *Writing about Multivariate Analysis*.
   a. $Y_1 = \beta_0 + \beta_1 X_1$ (in the original, untransformed units of both the dependent and independent variables, with unstandardized coefficients)

b. $Y_1 = \beta_0 + \beta_1 X_1$ (in the original, untransformed units of both the dependent and independent variables, but specifying standardized coefficients)
c. $\ln Y_1 = \beta_0 + \beta_1 X_1$ (a lin-log model)
d. $Y_1 = \beta_0 + \beta_1 \ln X_1$ (a log-lin model)
e. $\ln Y_1 = \beta_0 + \beta_1 \ln X_1$ (a double-log model)

2. Using the same variables as in question B.1, estimate a model with a quadratic specification of X_1: $Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_1{}^2$.
   a. Calculate the predicted value of Y_1 for selected values of X_1 that span its observed range in your data.
   b. Create a chart to show the shape of the estimated relationship between Y_1 and X_1, using the results from part a and following the guidelines in chapter 6 of *Writing about Multivariate Analysis*.
   c. Calculate differences in predicted values of Y_1 for one-unit increases in X_1.
   d. Consider whether other increments of X_1 are better suited to your research question and data (see pages 177–182 of *Writing about Multivariate Analysis*). If so, repeat part c using those increments instead of one-unit increases.
   e. Write a sentence to describe the relationship between Y_1 and X_1 across the observed range of X_1 in your data, using the calculations from parts c or d.
   f. Use the model goodness of fit statistics to test whether the quadratic specification of X_1 statistically significantly improves the fit of the model compared to a linear specification of X_1. Contrast this against your conclusions based on the test statistic for β_2.
   g. Optional: Use a spreadsheet to perform questions B.2a through B.2d, following the instructions in appendix D of *Writing about Multivariate Analysis*.

3. Using data on the dependent variable used in the preceding question and a binary independent variable (denoted *DUMMY* in the equations below, coded 1 for a specified value and 0 for the reference category),
   a. Estimate an OLS model of the specification: $Y_1 = \beta_0 + \beta_1 DUMMY$.
   b. Write a sentence interpreting β_1, following the guidelines in chapter 9 of *Writing about Multivariate Analysis*.
   c. Using the estimated coefficients from part a, calculate predicted values of Y_1 for cases in the reference category and the other category of *DUMMY*. Compare these against the mean value of Y_1 for each of those categories of *DUMMY* from a bivariate calculation.

4. Using the same variables that you used for Y_1, X_1, and *DUMMY* in questions B.1 and B.3, estimate an OLS model with an interaction between X_1 and *DUMMY*.
   a. Write an equation to convey the model specification, including both main effects and interaction terms.
   b. Calculate predicted values of Y_1 for cases in the reference category and those in the other category of *DUMMY* across the observed range of X_1 in your data.

c. Create a chart showing the shape of the estimated relationship among Y_1, X_1, and *DUMMY,* using the results from part b. (See chapter 6 of *Writing about Multivariate Analysis* for guidelines.)

d. Calculate differences in predicted values of Y_1 for one-unit increases in X_1 for cases with each value of DUMMY.

e. Using the GEE approach, write a paragraph describing the interaction between Y_1, X_1,and *DUMMY,* using the guidelines under "Interactions" on pages 314–315 of *Writing about Multivariate Analysis*.

f. Optional: Use a spreadsheet to perform questions B.4b through B.4d, following the instructions in appendix D of *Writing about Multivariate Analysis*.

5. Using the same variables for Y_1 and *DUMMY* as in question B.4, and a three-category independent variable (*CATEGVAR*) from your data set, estimate an OLS model with an interaction between *DUMMY* and *CATEGVAR*. (Hint: Before you specify the model, create dummy variables for two of the three categories of *CATEGVAR,* following the guidelines on page 212 of *Writing about Multivariate Analysis*.)

   a. Write an equation to convey the model specification, including both main effects and interaction terms. Use this equation to help you define appropriate dummy variables to specify the interaction.

   b. Calculate the predicted values of Y_1 for all possible combinations of the variables *DUMMY* and *CATEGVAR*.

   c. Create a chart showing the shape of the estimated relationship between Y_1, *DUMMY,* and *CATEGVAR,* using the results from part b. See chapter 6 of *Writing about Multivariate Analysis* for guidelines.

   d. Using the GEE approach, write a paragraph describing the interaction between Y_1, *DUMMY* and *CATEGVAR*. See "Interactions" on pages 314–315 of *Writing about Multivariate Analysis* for example wording.

   e. Optional: Use a spreadsheet to perform questions B.5b and B.5e. See appendix D of *Writing about Multivariate Analysis* for spreadsheet guidelines.

6. Using data from your data set on a dichotomous dependent variable (Y_2), a continuous independent variable (X_1), and a categorical independent variable (*DUMMY*), estimate a logistic regression model of the form: $\text{logit}(Y_2) = \beta_0 + \beta_1 X_1 + \beta_2 DUMMY$. See your software manual for instructions on how to specify which category of your dependent variable to model.

   a. Write a sentence interpreting the value of β_1 using the guidelines on pages 221 and 226 of *Writing about Multivariate Analysis* for writing about odds ratios.

   b. Write a sentence interpreting the value of β_2.

C. REVISING

1. Repeat questions A.1 through A.3 for a results section you have written previously that describes results from an OLS regression.

2. Repeat question A.6 for a results section you have written previously that describes results from a logistic regression analysis of a binary dependent variable.

9 Quantitative Comparisons for Multivariate Models

SOLUTIONS

1. Correct the given statements, if they are not already correct.
   a. "The odds ratio of passing the test was 0.60 for students in School A compared to School B, meaning that students in School A were only 60% as likely to pass as those in School B." (Or " . . . , meaning that students in School A were 40% less likely to pass than those in School B.")
   b. Correct as written.
   c. "Relative odds of migration for ever-married men were 0.91, reflecting lower chances of migration for ever-married than never-married men."
   d. "The standardized beta for widows was −0.5, meaning that widows scored on average half a standard deviation lower than nonwidows."
   e. Correct as written.
   f. "The relative risk dropped from 2.50 to 2.00 between the unadjusted and adjusted models, corresponding to a 33% reduction in excess risk."

3. Answer these questions using the information in table 9A (Zimmerman 2003).
   a. The dependent variable is cumulative GPA, a continuous variable measured in points, with a theoretical range from 0.0 to 4.0.
   b. An OLS model is suitable because the dependent variable is continuous.
   c. The continuous independent variables are own and roommate's verbal and math SAT scores, each divided by 100 (see row labels) in the model specification shown in table 9A. Because SAT scores can range from 200 to 800 points, this transformation (change of scale) means that each of these variables could range from 2.0 to 8.0.
   d. The categorical independent variables in the model are gender (ref. = male) and race (ref. = white American citizens, with five dummy variables, one for each of the other racial/citizenship groups [black, Hispanic, Native American, Not a U.S. citizen, Asian]).

5. The difference in GPA would be roughly 0.08 points if the student had a verbal SAT score of 720 instead of 680. Calculate this change by multiplying the coefficient for own verbal SAT (0.195) by the requested difference in SAT score (40 points, divided by 100 in accordance with the model specification). $0.195 \times 0.40 = 0.078$.

7. His predicted GPA would be $2.906 = 0.780 + [(720/100) \times 0.195] + [(700/100) \times 0.092] + [(680/100) \times 0.027] + [(650/100) \times -0.016]$. No terms are needed for race or gender because they are the reference categories, which are captured in the intercept term.

9. Write sentences to convey the results in table 9B (Light 2004).
   a. "For women, the transition from single to married is associated with a predicted gain of 0.44 in log(family income)."
   b. "For women, the transition from single to married is associated with a 55% increase in family income." (Percentage change calculation: $100 \times [\exp(0.440) - 1] = 55\%$.)
   c. "For men, the transition from single to married is associated with a 3% loss in family income, but the difference is not statistically significant." (Percentage change calculation: $100 \times [\exp(-0.035) - 1] = 3.4\%$; assessment of statistical significance: *t*-statistic $= -0.035/0.025 = -1.40$, which is below the critical value for $p < 0.05$.)
   d. "A woman with an income of $20,000 while single is predicted to gain roughly $11,000 in family income if she marries." (Calculation: $20,000 × 0.55 = $11,054.)

11. Calculate the relative odds of first migration for the given situations using the results in table 9C (Fussell and Massey 2004).
   a. The relative odds of migrating for an ever-married man compared to a never-married man = 0.91. (Exponentiate the coefficient on ever-married; $\exp[-0.09] = 0.91$.)
   b. The relative odds of migrating for a 30-year-old man compared to a 20-year-old man = 0.59. Use the following expression, which plugs a ten-year age difference into the linear and square terms on age: $\text{Exp}[(30 \times [-.003]) + (30^2 \times [-0.001])]/\text{Exp}[(20 \times [-.003]) + (20^2 \times [-0.001])] = 0.59$.
   c. The relative odds of migrating for a man with a parent who is a prior U.S. migrant compared to a man without parents who migrated there = 1.67. (Exponentiate the coefficient on "parent is a prior U.S. migrant"; $\exp[0.51] = 1.67$.)
   d. The relative odds of migrating for a man from a community with a migration prevalence ratio (MPR) of 0–4 compared to a man from a community with an MPR of 10–14 = 0.37. (Exponentiate the coefficient on MPR = 0–4; MPR = 10–14 is the reference category; $\exp[-0.99] = 0.37$.)
   e. The relative odds of migrating for a man from a community with a migration prevalence ratio (MPR) of 0–4 compared to one from a community with an MPR of 60 or more = 0.26. (Divide the relative odds for an MPR of 0–4 by the relative odds for an MPR of 60+ to "cancel" the 10–14 MPR reference group; $0.37/1.40 = 0.26$.)

13. The odds of first migration for a 20-year-old never-married man with no children, eight years of education, 24 months of labor force participation, neither parents nor siblings who are prior migrants, from a community with an MPR of 10–14 are calculated: exp[−3.31 + (20 × [−0.003]) + (20^2 × [−0.0001]) + (8 × [−0.04]) + (24 × [−0.002])] = 0.016 or 1.6%. No terms are needed for MPR, marital status, children, or parent or sibling migrants, as those values are all in the reference category.

15. Using the results for the total sample:

a. **Table 9E. Predicted self-esteem by gender and widowhood status, CLOC sample, 1987–1994**

	Male	Female
Widow	1.62	1.72
Nonwidow	2.13	1.53

Explanation: Each of the cells includes the intercept. The "female/nonwidow" cell adds in the coefficient on the "female" dummy; the "male/widow" cell adds in the coefficient on the "widow" dummy; the "female/widow" cell adds in both of those coefficients along with the "female × widow" interaction term. (Note: Results differ from those shown in Carr [2004] because they do not include values of other variables in her model that are excluded from table 9D.)

b. Chart to present predicted self-esteem for each of the four possible combinations of gender and widowhood status (Carr 2004).

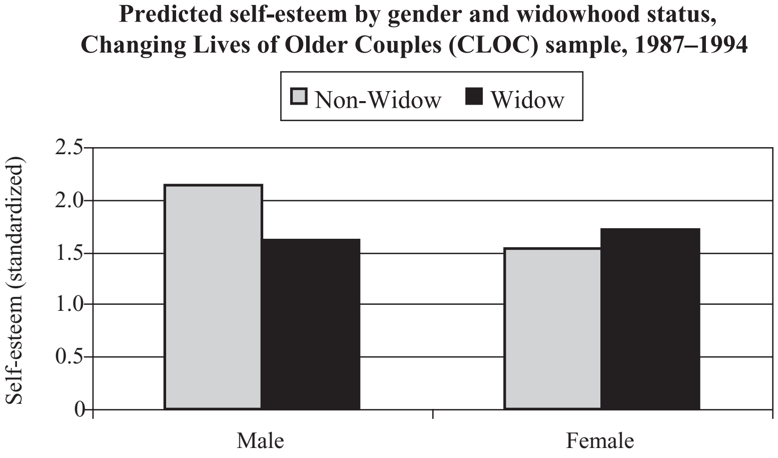


Figure 9A.

c. "As shown in table 9E, the association between widowhood and self-esteem differs by gender. Among males, self-esteem averages nearly half a standard deviation unit lower among widows than among those whose spouses are still alive at wave 2 (1.62 versus 2.13 points, respectively). Among females, however, widows have higher self-esteem than nonwidows (1.72 and 1.53, respectively)."

17. Calculate the odds ratio and relative risk with the following information.
    a. Assuming an odds ratio of 3.0 and a prevalence of the outcome (hospital admission) among the unexposed (nondiabetics) of 0.20, the corresponding relative risk of hospital admission for diabetics = 3.0/[(1–.20) + (3.0 × .20)] = 3.0/[0.8 + 0.6] = 3.0/1.4 = 2.14
    b. With an estimated odds ratio of 3.0 and a corresponding relative risk of 2.14, the percentage difference is calculated: [3.00 – 2.14]/2.14 × 100 = 40%. In other words, the estimated odds ratio overstates the relative risk by 40%.
    c. "Diabetics are more than twice as likely as nondiabetics to be admitted to the hospital."

10

Choosing How to Present Statistical Results

PROBLEM SET

Answer questions 1 through 3 using the information in table 10A .

Table 10A. Estimated coefficients and standard errors from a model of cumulative grade point average by own SAT scores and roommate's SAT scores, Williams College classes of 1999–2001

	Student's own combined math & verbal SAT score		
	Lowest 15%	Middle 70%	Top 15%
Own verbal SAT score/100	0.205	0.199	0.118
	(0.039)	(0.015)	(0.055)
Own math SAT score/100	0.065	0.112	0.045
	(0.036)	(0.017)	(0.051)
Race (ref. = white)			
Black	–0.181	–0.386	–0.800
	(0.046)	(0.053)	(0.059)
Hispanic	–0.036	–0.254	–0.050
	(0.059)	(0.046)	(0.274)
Native American	–0.238	0.212	dropped
	(0.169)	(0.168)	
Not a U.S. citizen	0.076	0.126	0.055
	(0.091)	(0.055)	(0.066)
Asian	0.210	–0.065	–0.201
	(0.120)	(0.026)	(0.047)
Female	0.262	0.103	0.107
	(0.038)	(0.016)	(0.028)
Roommate's verbal SAT score/100	0.006	0.043	–0.013
	(0.025)	(0.012)	(0.021)
Roommate's math SAT score/100	–0.038	–0.021	0.030
	(0.028)	(0.012)	(0.022)
Sample size	450	2,072	629
R^2	0.41	0.27	0.21

Source: Adapted from David A. Zimmerman, "Peer Effects in Academic Outcomes: Evidence from a Natural Experiment," *Review of Economics and Statistics* 85.1 (2003): 9–23, table 4.

1. For the estimated coefficient on female gender among students with combined SATs in the lowest 15%:
   a. What is the t-statistic?
   b. What is the 95% confidence interval?
   c. What is the 99% confidence interval?
   d. What is the p-value based on a 2-tailed test?
   e. If * denotes $p < 0.05$ and ** denotes p < 0.01, what symbol would accompany the “female” coefficient?

2. Among students in the middle 70% of combined SAT scores, which of the following differences in GPA are statistically significant?
   a. That between black and white students
   b. That between black and Hispanic students
   c. That between Hispanic and Native American students
   d. What additional information (if any) do you need to conduct a formal statistical test for these differences?

3. Answer the following questions using the information in table 10A.
   a. Three models are shown in table 10A. How do they differ? How can you tell from the table?
   b. Is the relationship between gender and GPA statistically significantly different across categories of own combined SAT score?
   c. What additional information (if any) do you need to conduct a formal statistical test for this difference?

Answer questions 4 through 8 using the information in table 10B.1.

4. What are the lower and upper 90% confidence limits for 1998 median income for all households?
5. Is the change in real household income between 1998 and 1999 statistically significant at $p < 0.10$:
   a. For all households?
   b. For family households?
   c. For nonfamily households?

6. What is the standard error associated with the 1998 estimate of median income for nonfamily households with a female householder? Explain how you calculated it.

7. Calculate 95% confidence intervals around estimated median income for each household type in table 10B.1 and show the results in a new table. Hints: Use the critical value for $p < 0.10$ based on a large sample to calculate the standard error of each estimate. Then multiply the standard error by 1.96 to obtain the 95% CI. A spreadsheet vastly simplifies these calculations.

Table 10B.1. Median income (constant 1999$) by type of household, United States, 1998 and 1999

	1998		1999	
Type of Household	Median income	90% confidence interval (+/–)	Median income	90% confidence interval (+/–)
Family households	48,517	419	49,940	449
Married-couple families	55,475	541	56,827	502
Female householder, no husband present	24,932	669	26,164	594
Male householder no wife present	40,284	1,670	41,838	1,311
Nonfamily households	23,959	477	24,566	444
Female householder	19,026	472	19,917	454
Male householder	31,086	572	30,753	568
All households	39,744	387	40,816	314

Source: U.S. Census Bureau, *Current Population Report*s, P60-209, *Money Income in the United States: 1999* (Washington, DC: U.S. Government Printing Office), table A.

8. Create a table that shows change in median income for each household type between 1998 and 1999, denoting differences that are statistically significant at $p < 0.10$ with a dagger.

   Answer questions 9 and 10 using the information in table 10C.

9. For the estimated coefficient on "ever-married," calculate:
   a. The test statistic (name it)
   b. The p-value
   c. The 95% confidence interval for the coefficient (e.g., the 95% CI around the log-odds point estimate)

10. Revise table 10C to report odds ratios with associated 95% confidence intervals and symbols to denote statistical significance instead of log-odds and standard errors.

Table 10C. Estimated log-odds of first trip to the United States, Men, 1987–1998 Mexican Migration Project

	Log-odds	Standard error
Demographic background		
Age (years)	–0.003	0.02
Age-squared	–0.001	0.0002
Ever married	–0.09	0.06
Number of minor children in household	0.01	0.01
Human capital		
Years of education	–0.04	0.006
Months of labor-force experience	–0.002	0.0007
Social capital in the family		
Parent a prior U.S. migrant	0.51	0.05
Siblings prior U.S. migrants	0.36	0.02
Social capital in the community		
Migration prevalence ratio[a]		
0–4	–0.99	0.15
5–9	–0.09	0.12
(10–14)		
15–19	0.35	0.10
20–29	0.57	0.13
30–39	0.95	0.15
40–59	0.74	0.19
60 or more	0.34	0.15
Intercept	–3.31	0.26
– 2 log likelihood	23,369.2	
Df	26	

Source: Adapted from Elizabeth Fussell and Douglas S. Massey, “The Limits to Cumulative Causation: International Migration from Mexican Urban Areas,” *Demography* 41.1 (2004): 151–71. Table 2, http://muse.jhu.edu/journals/demography/v041/41.1fussell.pdf.

Note: Model also includes controls for occupational sector, internal migratory experience, community characteristics, and Mexican economic and U.S. policy context.

[a] The migration prevalence ratio = the number of people aged 15+ years who had ever been to the U.S./the number of people aged 15+ years ×100.

10 Choosing How to Present Statistical Results

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. Find a journal article in your field about an application of an OLS model.
   a. Which approaches to presenting statistical significance results do the authors use?
   b. Do the authors label those approaches adequately in the text (e.g., identifying the type of test statistic)? In the tables?
   c. If the authors used more than one approach to presenting statistical significance results, are those approaches complementary or redundant with one another?
   d. Would a different or additional approach be more suitable for that intended audience? If so, name it and, if the information in the article is sufficient, calculate it for each variable in one of their models.
   e. Do the authors mention whether their statistical tests are 1-tailed or 2-tailed?
   f. Do the authors specify the number of degrees of freedom for their models?

2. Does the article used in question A.1 address any hypotheses *other than* the null hypothesis (e.g., $\beta_i = \beta_j$, or tests across models)?
   a. If so, do the authors provide information such as test statistics or variance-covariance matrices to test those hypotheses formally? Are their explanations of those hypothesis test results clear?
   b. If they don't test other hypotheses, are there others that would suit their research question? If you had access to their data, what approach would you use to present results of those hypothesis tests to the same audience?

3. Find a journal article in your field about an application of an OLS model with standardized coefficients.
   a. Which approaches to presenting statistical significance results do the authors use?
   b. Are the units of the statistical test information consistent with the units of the standardized coefficients? If not, suggest a correct alternative for presenting statistical test results.

4. Find a journal article in your field about an application of a logistic regression of a binary dependent variable.
   a. Which approaches to presenting statistical significance results do the authors use?
   b. Are the units of the statistical test information consistent with the units in which they present the effects' estimates (log-odds or odds ratios)? If not, suggest a correct alternative for presenting statistical test results.

5. Obtain a copy of a leading journal in your field.
   a. Which approaches to presenting statistical significance results are specified in the instructions for authors for that journal?
   b. If they do not specify a particular approach to presenting statistical significance, which ones are mostly widely used in the journal?
   c. Critique those choices, given the intended audience for that journal.

6. Find a report about a survey in your field or at Web sites such as the Census or Bureau of Labor Statistics.
   a. Which approaches to presenting statistical significance results are used?
   b. Who is the intended audience for that report or Web site?
   c. Do the approaches used to present statistical significance suit that audience?

B. APPLYING STATISTICS

Note: These questions use the regression output from the "applying statistics" questions in the suggested course extensions to chapter 9. See notes to those questions for additional information about the types of variables and notation used below.

1. Using the OLS regression output from question B.4 in the suggested course extensions for chapter 9, identify or calculate each of the following for each of the coefficients in the model. Most of these pieces of information can be requested as part of the computerized output.
   a. The standard error
   b. The test statistic (name it)
   c. The *p*-value based on a 2-tailed test
   d. The *p*-value based on a 1-tailed test
   e. The 95% confidence interval
   f. The 99% confidence interval
   g. The symbol denoting level of statistical significance, assuming a 2-tailed test, if ** denotes $p < 0.01$ and * denotes $p < 0.05$.

2. Create tables to present results of the OLS model in the preceding question for each of the following audiences or objectives, using the criteria in chapters 5 and 10 and appendix B of *Writing about Multivariate Analysis*:
   a. A paper to be submitted to the journal you used in question A.5
   b. A 15-page report for a nonstatistical audience interested in the issues you study
   c. A five-minute presentation to a lay audience interested in the issues you study

3. Use the same data and variables Y_1 and *CATEGVAR* as in question B.5 from the suggested course extensions for chapter 9 to perform the calculations below. (Reminder: Y_1 is a continuous dependent variable and *CATEGVAR* is a three-category independent variable from which two dummy variables [denoted *CAT1* and *CAT2* in the equations below] have been created; label yours to reflect their actual content!)
   a. Estimate a model of the form $Y_1 = \beta_0 + \beta_1 CAT_1 + \beta_2 CAT_2$, requesting the variance-covariance matrix for the model.
   b. Perform a ballpark assessment of whether $\beta_1 = \beta_2$, using the approach described on page 250 of *Writing about Multivariate Analysis*.
   c. Use information from the variance-covariance matrix to calculate the test statistic for whether $\beta_1 = \beta_2$, following the instructions under "Standard Error of the Difference" on page 248 of *Writing about Multivariate Analysis*.
   d. Write a sentence to report the conclusions of that test, with reference to the specific variables and concepts in your model.
   e. Reestimate the same model as in part a, requesting a formal statistical test for $\beta_1 = \beta_2$. Compare your conclusion based on this approach to your conclusion based on the method used in part c.

4. Using the same data and variables as in question B.4 in the suggested course extensions for chapter 9, estimate stratified models (one for the subset of cases for whom *DUMMY* = 1, a separate model for cases for whom *DUMMY* = 0) of the form $Y_1 = \beta_0 + \beta_1 X_1$. (Reminder: Y_1) a continuous dependent variable and X_1 is a continuous independent variable.)
   a. Calculate the statistic to test whether β_1 is statistically significantly different across the models for the two subsamples. (This is one way to test whether *DUMMY* and X_1 interact in their association with Y_1.}
   b. Compare your conclusions about the statistical significance of this interaction based on the stratified models test with your conclusions based on the test statistics for the interaction term between *DUMMY* and X_1 in the model estimated for question B.4 in the suggested course extensions for chapter 9.

5. Using the logistic regression output from question B.6 in the suggested course extensions for chapter 9, identify or calculate each of the following for each of the coefficients in the model. Most of these pieces of information can be requested as part of the computerized output.
   a. The standard error
   b. The test statistic (name it)
   c. The *p*-value based on a 2-tailed test
   d. The *p*-value based on a 1-tailed test
   e. The 95% confidence interval for the coefficient (e.g., the 95% CI around the log-odds point estimate)
   f. The odds ratio
   g. The 95% confidence interval for the odds ratio
   h. The symbol denoting level of statistical significance, assuming a 2-tailed test, if ** denotes $p < 0.01$ and * denotes $p < 0.05$

6. Create tables to present results of the logistic regression model from the preceding question for each of the following audiences or objectives, using the criteria in chapters 5 and 10 and appendix B of *Writing about Multivariate Analysis*.
   a. A paper to be submitted to the journal you used in question A.5
   b. A 15-page report for a nonstatistical audience interested in the issues you study
   c. A five-minute presentation to a lay audience interested in the issues you study

C. WRITING AND REVISING

1. Repeat questions A.1 and A.2 for a results section you have written previously that describes results of an OLS regression.

2. Revise or create tables to present results of that OLS model for each of the following audiences or objectives, using the criteria in chapters 5 and 10 and appendix B of *Writing about Multivariate Analysis*.
   a. A paper to be submitted to a leading journal in your field
   b. A 15-page report for a nonstatistical audience interested in the issues you study
   c. A five-minute presentation to a lay audience interested in the issues you study

3. Repeat question A.4 for a results section you have written previously that describes results of a logistic regression analysis of a binary dependent variable.

4. Repeat question C.2 with the results of that logistic regression.

10 Choosing How to Present Statistical Results

SOLUTIONS

1. For the estimated coefficient on female gender among students with combined SATs in the lowest 15%:
   a. The *t*-statistic = 6.985 (= coefficient/standard error = 0.262/0.038).
   b. The 95% confidence interval is 0.188, 0.336 (= 0.262 ± [1.96 × 0.038])
   c. The 99% confidence interval is 0.165, 0.359 (= 0.262 ± [2.56 × 0.038])
   d. $p < 0.001$ based on the *t*-statistic of 6.99 and criteria for a large sample.
   e. ** would accompany the "female" coefficient.

3. Answer these questions using the information in table 10A (Zimmerman 2003).
   a. There is one model for each of three subsamples of combined own SAT score: students in the bottom 15% of the Williams College SAT range, those in the middle 70%, and those in the top 15%. This information is presented in the column spanner ("Student's own combined math & verbal SAT score") and column headers.
   b. The coefficient for "female" is statistically significantly higher in the bottom 15% of SAT scores (0.262, s.e. = 0.038) than for the other two groups (β = 0.103, s.e. = 0.016), and β = 0.107, s.e. = 0.028 for the middle 70% and top 15% of SAT scores, respectively). The difference between the lower and middle groups, for example, is calculated 0.262 – 0.103 = 0.159. The corresponding standard error of the difference = $\sqrt{(0.038)^2 + (0.016)^2}$ = 0.016. Dividing the difference between coefficients by the standard error of the difference, we obtain 0.159/0.016, or a *t*-statistic of 9.94, which vastly exceeds the critical value of the test statistic for $p < 0.01$ for a sample of this size. However, the difference between the female coefficients for the upper two SAT groups is not statistically significant because the difference (–0.004 = 0.103 – 0.017) is swamped by the standard error of the difference.
   c. No additional information is needed to conduct a formal statistical test of this difference. The estimates and their standard errors are independent of one another because they are from separate (stratified) models. Hence we do not need to take the covariances into account, as would be necessary with interaction terms between gender and SAT group estimated within one model that pooled all SAT groups.

5. Consider real household income as reflected in table 10B.1.
   a. Yes, the change in real household income between 1998 and 1999 for all households is statistically significant at $p < 0.10$. The upper 90% CL for 1998 median income for all households ($40,131) is below the lower 90% CL for the corresponding figure for 1999 ($40,502). Hence the 90% confidence intervals for the respective years do not overlap, so the increase in median income from $39,744 to $40,816 is significant at $p < 0.10$. Because the estimates for the two years are independent, the covariance between estimates does not need to be taken into account when performing the test.
   b. Yes, the change in real household income between 1998 and 1999 for family households is statistically significant at $p < 0.10$. The upper 90% CL for 1998 median income for family households ($48,936) is below the lower 90% CL for the corresponding figure for 1999 ($49,491). Same logic as for part a.
   c. No, the change in real household income between 1998 and 1999 for nonfamily households is not statistically significant. The upper 90% CL for 1998 median income for nonfamily households ($24,436) is above the lower 90% CL for the corresponding figure for 1999 ($24,122). Hence the 90% confidence intervals for the two estimates overlap and we cannot conclude that they are statistically significantly different at $p < 0.10$.

7. The multiplier (critical value) for $p < 0.10$ and a large sample size is 1.64, so we divide the reported ± values from the 90% CI by 1.64 to obtain the standard error (s.e.) of each estimate. Then calculate the 95% CL as estimate ± (1.96 × s.e.), as shown in table 10B.2.

Table 10B.2. Median income (constant 1999$) with 95% CI, by type of household, United States, 1998 and 1999

	1998				1999			
Type of Household	Median income	Standard error	Lower 95% CL	Upper 95% CL	Median income	Standard error	Lower 95% CL	Upper 95% CL
Family households	48,517	255	48,016	49,018	49,940	274	49,403	50,477
Married-couple families	55,475	330	54,828	56,122	56,827	306	56,227	57,427
Female householder, no husband present	24,932	408	24,132	25,732	26,164	362	25,454	26,874
Male household, no wife present	40,284	1,018	38,288	42,280	41,838	799	40,271	43,405
Nonfamily households	23,959	291	23,389	24,529	24,566	271	24,035	25,097
Female householder	19,026	288	18,462	19,590	19,917	277	19,374	20,460
Male householder	31,086	349	30,402	31,770	30,753	346	30,074	31,432
All households	39,744	236	39,281	40,207	40,816	191	40,441	41,191

9. For the estimated coefficient on “ever-married,”
   a. The test statistic is the chi-square (χ^2) = $(\beta_k/\text{s.e.}_k)^2 = (-0.09/0.06)^2 = 2.25$.
   b. $p < 0.10$.
   c. The 95% confidence interval for the coefficient (e.g., the 95% CI around the log-odds point estimate) = −0.208, 0.028.

11

Writing Introductions, Conclusions, and Abstracts

PROBLEM SET

Answer questions 1 through 4 for a scientific paper about AIDS knowledge for different language groups in the United States (results shown in table 5.2 of *Writing about Multivariate Analysis,* 90–91). Assume you are writing for a social science journal with a 5,000-word limit for research articles (e.g., several double-spaced pages apiece for the introduction, literature review, and conclusion).

1. For your scientific paper,
   a. Write an outline of the introduction, including complete topic sentences for each major paragraph.
   b. List the kinds of numeric background information you would incorporate, and suggest useful types of quantitative comparisons to highlight why the topic is interesting or important.

2. Write an outline of the literature review, including headings for the different topics for which you would summarize published literature.

3. Write an outline of the concluding section, including notes on the following issues.
   a. How would you summarize the main numeric results?
   b. How would the statistical significance of findings influence the way you discuss the results?
   c. List the types of numeric background information you would use to show how findings of that study might be applied to health education programs in the United States.

4. Write a title, abstract, and keywords for the paper.

5. Write one or two paragraphs discussing the research implications of Mensch and colleagues' (2003) findings about how mode of interview relates to reporting of sensitive behaviors among adolescents (table 11A).

Table 11A. Odds ratios from logistic regressions of reporting sensitive behaviors, by mode of interview and gender, Kisumu District, Kenya, 2002

Behavior	Boys	Girls
Ever had a boyfriend or girlfriend		
Interviewer-administered	1.00	1.00
Self-administered	0.78	0.82
ACASI[a]	0.43***	0.69*
Ever had more than one sexual partner		
Interviewer-administered	1.00	1.00
Self-administered	1.02	0.72
ACASI[a]	1.28	2.35***
Ever had sex with a stranger		
Interviewer-administered	1.00	1.00
Self-administered	1.43	1.24
ACASI[a]	2.42**	4.25***
Ever tricked/coerced/forced into sex		
Interviewer-administered	1.00	1.00
Self-administered	2.33***	1.89**
ACASI[a]	2.40***	3.35***

Source: Adapted from Barbara S. Mensch, Paul C. Hewett, and Annabel S. Erulkar, "The Reporting of Sensitive Behavior by Adolescents: A Methodological Experiment in Kenya," *Demography* 40.2 (2003): 247–68, table 2, *http://muse.jhu.edu/journals/demography/v040/40.2mensch.pdf*.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] ACASI = audio computer-assisted self-interviewing.

11 Writing Introductions, Conclusions, and Abstracts

SUGGESTED COURSE EXTENSIONS

■ A. REVIEWING

1. Find a journal article about an application of multivariate analysis to a topic in your field. Critique it for the following, using the guidelines in chapter 11 of *Writing about Multivariate Analysis*:
   a. A clear introduction of the broad issues or questions to be investigated
   b. A review of the previous literature to identify theories and existing evidence
   c. A discussion and conclusions section that summarizes numeric findings and relates them back to the research question and to previous studies
   d. Consideration of causality and substantive significance of findings in the conclusions

2. Critique the abstract, keywords, and title to the article using the guidelines in chapter 11 and the instructions for authors for a leading journal in your field. Revise them to correct any problems you identify.

■ B. WRITING

Note: If you are writing a paper on a new multivariate analysis, complete these questions. If you have already written a draft of your paper, complete section C instead.

1. Write an introductory section for your paper following the guidelines in chapter 11 of *Writing about Multivariate Analysis*.

2. Write the discussion and conclusions section of your paper, including
   a. summaries of major numeric findings rather than repetition of detailed numbers from the results;
   b. discussion of causality, statistical significance, and substantive significance of findings;
   c. explanation of how your findings relate to initial hypotheses and to findings of other studies.

3. Write an abstract for your paper following guidelines in chapter 11 and the instructions for a journal in your field.

4. Investigate which online databases list the leading journals in your field. Write keywords to satisfy the criteria for that database, following the guidelines in chapter 11.

5. Write a title for your paper
   a. worded as a statement;
   b. worded as a rhetorical question.

■ C. REVISING

1. Critique the introductory section of a paper you have written previously, using the criteria in question A.1. Rewrite it to rectify any problems you have identified.

2. Critique the discussion and conclusions section of that paper using the criteria listed under question B.2. Rewrite it to rectify any problems you have identified.

3. Repeat question A.2 for your paper.

4. Exchange initial and revised drafts of the materials in questions C.1 through C.3 with someone writing about a different topic or data. Peer-edit the work.

11 Writing Introductions, Conclusions, and Abstracts

SOLUTIONS

1. For a scientific paper about AIDS knowledge:
   a. Outline of introduction to study of AIDS knowledge by language in the United States
      I. (Paragraph on why AIDS is of concern) Introductory sentence: "AIDS (Acquired Immunodeficiency Syndrome) is a leading cause of death in the United States."
      II. (Paragraph on why it is important to assess AIDS knowledge) Introductory sentences: "In the absence of a vaccine against AIDS, prevention must rely on individual behavior to avoid spread of the disease. It is unlikely that appropriate behavioral change will occur without knowledge about AIDS and how it is transmitted; hence it is important to assess levels of AIDS knowledge in the general population."
      III. (Paragraph on why language is an important possible mechanism related to AIDS knowledge) Introductory sentence: "Language can affect AIDS knowledge either through linguistic barriers or cultural differences."

   b. Kinds of numeric information to incorporate, and useful quantitative comparisons for an introduction to the AIDS knowledge paper.

      For paragraph I, statistics on levels and trends in AIDS prevalence and mortality in the United States, using percentage change to quantify trends over time in AIDS prevalence and mortality rates, and rank as a cause of death to indicate overall importance.

      For paragraph II, evidence on how knowledge about AIDS or other similar diseases such as STDs translates into changes in preventive behaviors.

      For paragraph III, statistics on how AIDS prevalence and mortality vary by language ethnic group, with supplementary evidence by race or socioeconomic status if statistics by language are not available. Use ratios or percentage difference to contrast rates across groups. Information on the number of persons, percentage share, and trends in number and share of major language groups in the U.S.

3. Outline of conclusion to study of AIDS knowledge by language in the United States
   a. Summarize the main numeric results.
      I. Summary of differences in AIDS knowledge by language group using GEE technique (English speakers did best, Spanish/Span-

ish did worst; example of size of differences for a representative AIDS topic)

II. Synthesis of which AIDS topics were best understood, least well understood using GEE approach (reporting % of respondents who answered questions correctly within broad conceptual groupings of AIDS knowledge topics, generalized across language groups where possible)

III. Description of how these knowledge patterns correspond to which topics are most important for people to understand (e.g., correct information about likely means of transmission is more essential than correct information about unlikely means of transmission)

b. Discuss only statistically significant differences across language groups or AIDS knowledge topics. For topics where language differences in knowledge were not statistically significant, describe overall knowledge levels only, not differences across groups.

c. To show how these results might be used to evaluate or influence health education programs, include statistics from other studies about

i. the availability of education materials that emphasize the most important AIDS transmission topics

ii. the association between AIDS knowledge and preventive behaviors

iii. availability of AIDS education materials in Spanish and other non-English languages

5. Research implications of the findings in table 6C (Mensch et al. 2003). "This study has shown that method of data collection has a substantial effect on reported levels of sensitive behaviors among adolescents. Teens were more likely to report normative behaviors such as having a boyfriend or girlfriend if questioned in person than using audio computer-aided self-interview (ACASI) techniques. For sensitive (stigmatized) behaviors such as having been coerced into sex, however, ACASI yielded higher rates than in-person interviews.

"These results have several implications for future research on similar topics and populations. First, the method of data collection should be chosen to maximize the chances of subjects reporting their true behavior instead of responding in ways that conform to perceived social norms about acceptability of that behavior. Second, results should not be compared across sources that used different methods of data collection, because apparent differences (or lack of differences) across groups could be attributable to reporting biases rather than differences in actual behavior."

12

Writing about Data and Methods

PROBLEM SET

1. For each of the following scenarios, list what information you would report in a data section for a scientific paper. Hint: what additional information would you want to know?
   a. A three-year study of a six-month drug rehabilitation program that recruited 200 subjects to examine cure and relapse rates
   b. A study of calcium intake among 50 pregnant women, based on their recall over a two-week period

2. Dr. Dollar is conducting a study of poverty patterns in the United States based on annual income data from the 2000 census. She defines a categorical measure of income group comparing family income (calculated from income of individual family members, alimony, and four types of social benefits) against the federal poverty thresholds. Classifications are defined in terms of multiples of the threshold: <.50, .50–.99, 1.00–1.84, 1.85–2.99, and 3.00 or greater. Search for "poverty" on the U.S. Census Web page (*http://www.census.gov*) for more detail. State how you would describe the poverty measure in
   a. a one-page summary of the study for a local newspaper;
   b. documentation of a new data set that has collected data on each of the income components as part of a written questionnaire;
   c. a journal article on poverty patterns, written for people who are familiar with poverty thresholds.

3. Making use of newly available data from a three-year panel study of a sample of 10,000 people drawn from the 2000 census, Dr. Dollar describes movement in and out of poverty and duration of poverty (in months) over the study period. Poverty was defined as family income below the threshold (<1.0). Data were collected annually, with retrospective recall of income in each of the previous 12 months. What information should be added to item 2.c to describe these data for this research question?

4. A researcher at the Panel Study of Income Dynamics accidentally erased a file containing information from two years' worth of data. Embarrassed, he went ahead and analyzed data for the other 30 years in the study. What assumptions did he implicitly make about the missing data?

5. Fauth et al. (2004) studied the effects of a residential mobility experiment, comparing outcomes of low-income adults who moved to public housing in low-poverty neighborhoods with outcomes for those who stayed in public housing in their original high-poverty neighborhoods. They studied the six neighborhood and housing quality measures shown in table 12A. What information about these variables should be included in a data section for a scientific paper about this study?

Table 12A. Means and standard deviations of neighborhood and housing characteristics, Yonkers Residential Mobility Program, 1994–1995

Measure	Mean	Standard deviation
Danger (3 items)	0.72	0.91
No. of victimizations in past year (1 item)	0.21	0.58
Disorder (5 items)	0.72	0.74
Cohesion (4 items)	0.52	0.32
Resources (5 items)	2.98	0.60
Housing quality (5 items)	0.35	0.43

Source: Adapted from Rebecca C. Fauth, Tama Leventhal, and Jeanne Brooks-Gunn, "Short-term effects of moving from public housing in poor to middle-class neighborhoods on low-income, minority adults' outcomes," *Social Science and Medicine* 59 (2004): 2271–84, table 1, *http://www.sciencedirect.com/science*.

6. For each of the following data, methods, and objectives, write a short discussion of strengths and limitations for the concluding section of a scientific article.
   a. Study: 20 subjects were interviewed at the Snooty Golf Club at noon on a Friday in early April regarding their preferred color and fit of jeans. Objective: a marketing study by the Gap clothing store.
   b. Study: two classes of second graders in the same school were given a math test in September. One class was then taught with a new math curriculum, the other with the standard curriculum. The classes were tested again in June. Objective: an evaluation of the new math curriculum.
   c. Study: data on hair color and age were collected for everyone aged 25–84 in a city of 200,000 people. Deaths over a two-year period were ascertained from death certificates. Two models were estimated: one with hair color as the independent variable and mortality as the dependent variable; the second with age as another independent variable. Objective: understand the potential benefit of hair dye in improving survival.

7. In her study “Gender, Preloss Marital Dependence, and Older Adults’ Adjustment to Widowhood,” Carr (2004) uses data on respondents who were widowed between waves 1 and 2 of the study, matched to control subjects who remained married at wave 2. (See table 9D for more on her study.) Carr’s study used data from a longitudinal study over a seven-year period. In her methods section, she describes a model of attrition (nonparticipation at wave 2) from the sample between waves 1 and 2. She found that “age and anxiety increased the risk of nonparticipation, and home ownership decreased the risk of nonparticipation at wave 2.” None of the other demographic, socioeconomic, or health characteristics were associated with attrition.
   a. Write an equation to convey her final specification for the model of attrition, including the dependent variable and type of model estimated.
   b. What questions is she trying to answer with that model?
   c. Write a short discussion of the implications of her attrition findings for interpretation of her results about psychological adjustment to widowhood.

12 Writing about Data and Methods

SUGGESTED COURSE EXTENSIONS

■ A. REVIEWING

1. In a one- or two-page article in the health or science section of a newspaper or magazine, circle the information on data and methods.
   a. Critique the presentation of that information, using the guidelines on pages 273–75 of *Writing about Multivariate Analysis* regarding writing about data and methods in general-interest articles for a lay audience.
   b. Assess whether additional information would be helpful for people seeking information to compare with findings from another study.
   c. Evaluate the discussion of how the data and methods affect interpretation of the findings.

2. Read the data and methods section from an article about an application of OLS regression in a journal from your field.
   a. Critique the presentation of that information, using the guidelines in chapter 12 regarding writing about data and methods for scientific articles.
   b. List additional information needed by researchers seeking to replicate the data collection.
   c. List additional information needed by researchers seeking to replicate the statistical analysis.
   d. Assess how well the article discusses ways that the data and methods affect interpretation of the findings.
   e. Indicate whether the authors suggest directions for future research.
   f. Rewrite the description of data and methods in the discussion to rectify problems you identified in parts d and e.

3. Read the methods section of an article about an application of logistic regression in a journal from your field.
   a. Evaluate whether the categories of the dependent variable were defined in the raw data or calculated by the authors. If the latter, indicate whether the authors specified the criteria or cutoffs used to perform the classification.
   b. Indicate whether the authors identify the omitted category of the dependent variable in the text and the tables.

4. Go to a data Web site such as the U.S. Census Bureau, National Center for Health Statistics, or the Bureau of Labor Statistics and identify a topic of interest involving two or three variables. Evaluate the Web site in terms of how easy it is to find information about
   a. the type of study design (e.g., cross-sectional sample survey, retrospective, prospective);
   b. the data sources (e.g., vital registration forms, questionnaires, administrative records);
   c. the wording of questions used to collect the variables of interest to you;
   d. the units or coding of those variables;
   e. sampling weights, if applicable;
   f. the response rate;
   g. loss-to-follow-up (for longitudinal studies only).

B. WRITING

1. Outline the data section for a scientific paper about a multivariate analysis you are conducting, using the checklist in chapter 12 of *Writing about Multivariate Analysis*.

2. Write an equation to convey your final model specification.

3. Write an explanation of why you chose the type of statistical model used in your analysis given your research question and data, following the guidelines in chapter 12.

4. Write an explanation of how you arrived at your final model specification following the guidelines on pages 290–93 of *Writing about Multivariate Analysis,* including the following topics:
   a. The criteria used to determine which variables were included in the model, with reference to your specific research question.
   b. Whether and why nonlinear specifications were used for any of the independent variables.
   c. Whether interactions were included among two or more independent variables, and if so, which ones and why.

4. Write a discussion of the strengths and limitations of your data and methods for a scientific audience.

5. Exchange your answers to questions B.1 through B.4 with someone studying a different topic or data. Peer-edit each other's work.

6. Write a short discussion for a lay audience about how strengths and limitations of your data and methods affect your study conclusions.

C. REVISING

1. Critique a data and methods section of a scientific paper you have written previously, using the criteria in chapter 12 of *Writing about Multivariate Analysis*.
   a. Identify elements you have omitted.
   b. Track down that information in data documentation or other publications on the same data.
   c. Identify material that could be organized better or explained more clearly
   d. Revise your data and methods section to fix the problems you identified in parts a and c.

2. Critique the discussion of data and methods in the discussion section of a scientific paper you have written previously, using the guidelines on pages 294–97 of *Writing about Multivariate Analysis*.
   a. Identify implications of strengths or limitations of the data that were omitted or explained poorly.
   b. Identify directions for future research related to your data and methods that were omitted or explained poorly.
   c. Revise your discussion section to correct the problems you identified in parts a and b

3. Exchange your answers to questions C.1 and C.2 with someone studying a different topic or data. Peer-edit each other's work.

4. Exchange data and methods sections with someone who is analyzing different data and a different research question. Using only the information in that section (e.g., without reference to the computer output or data documentation and without asking him or her any questions),
   a. write an equation to express their final model specification (or a selected model if several models are presented in the paper). If some of the information needed to write an equation is missing information, list it;
   b. identify the units or coding and omitted categories for each variable in the final model specification (or a selected model) based on the data section and tables of descriptive statistics. If any of this information is missing, unclear, or inconsistent between the tables and prose, list it;
   c. rewrite your data and methods section to correct the problems identified by your peer-editor.

12 Writing about Data and Methods

SOLUTIONS

1. Information you would report in a data section for a scientific paper for the specified studies.
   a. When, where, who (demographic characteristics) was studied? How were they recruited? What was the baseline response rate among recruits? What percentage of the initial sample was lost to follow-up and how? How did the sample compare demographically to all clients at that rehab center? How were "cure" and "relapse" defined and measured? By whom were these assessments made?
   b. Again, the Ws. How were they recruited, what was the response rate, and how did the sample compare to all pregnant women? Were they asked specifically about calcium intake or to list foods? Open- or closed-ended questions about food?

3. Loss to follow-up, how income data were collected (using what methods and data sources? total or by components? in what ranges? continuous or categorical?).

5. Information on each of the items used to comprise each of the six outcome measures (dependent variables) and the method of data collection. Information on the development, reliability, and validity of those items. For example, what was the wording of the three items included in the "danger" scale? How were they coded? From what sources were those items drawn? Are those three items the standard measure of danger in other related studies? If not, how were they developed? Were they pretested on similar populations?

7. With regard to the analysis of attrition in Carr's study on widowhood:
   a. Logit (attrition) = $\beta_0 + \beta_1$Age + β_2Anxiety + β_3Homeowner.
   b. Whether those who participated at wave 2 were representative of the original wave 1 sample in terms of major sociodemographic and health characteristics.
   c. "An analysis of attrition showed that older respondents, those with higher anxiety, and those who did not own their homes were more likely to drop out between waves 1 and 2. As a consequence, these results about psychological adjustment to widowhood may not be generalizable to people in those groups because they were underrepresented in the sample used in this analysis."

13 Writing about Distributions and Associations

PROBLEM SET

1. Write descriptions of
   a. the age, gender, and racial distributions shown in table 5.3 (*Writing about Multivariate Analysis,* 93);
   b. the distribution of major categories of federal outlays in figure 6.2b (ibid., 124).

2. Write a description of the race/household type associations in table 5.1 (*Writing about Multivariate Analysis,* 84), using the GEE approach. Hint: To compare across racial/ethnic groups, report percentage distribution of household type within each race. Why are percentages preferred to counts in this case?

3. Use the results from Zimmerman's (2003) analysis of cumulative college grade point averages (GPAs) to answer the following questions.
   a. Among students in the middle 70% of SAT scores, the coefficient for "female" is 0.107 with a standard error of 0.016. Write a sentence explaining the direction, magnitude, and statistical significance of that finding.
   b. Among students in the bottom 15% of SAT scores, the coefficient for the variable "roommates' math SAT score/100" is −0.038 with a standard error of 0.028. Write a sentence interpreting that finding, assuming that roommates' math SAT scores range from 400 to 800.

4. Write a description of the age pattern of mortality shown in figure 6.10 (*Writing about Multivariate Analysis,* 136). Use descriptive phrases to convey the shape of the pattern, then document with appropriate numeric evidence. Incorporate selected quantitative comparisons to illustrate the sizes of differences in the chart.

5. In the analysis conducted by Mensch et al. (2003), the association between mode of interview and odds of boys reporting a sensitive behavior differs by the type of behavior in question (table 6C). What is such a pattern called in statistical terms? In GEE lingo? Write paragraphs to describe that pattern to
   a. a group of first-year high school students;
   b. a group of graduating statistics majors.

13

Writing about Distributions and Associations

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. In a journal article in your field, find descriptions of univariate distributions for each of the following types of variables. Critique them, using the criteria in chapter 13 of *Writing about Multivariate Analysis*.
   a. A nominal variable
   b. An ordinal variable
   c. An interval or ratio variable with many possible values

2. For each of the descriptions in question A.1
   a. Identify the criteria the author used to select which value(s) to highlight. Does that value match the research question and introductory material in the article?
   b. If all values are described with equal emphasis, assess whether one or more values should be featured and explain why.

3. In a journal article in your field, find descriptions of each of the following types of bivariate associations. Critique them, using the principles in chapter 13.
   a. An association between two categorical variables
   b. An association between a categorical and a continuous variable
   c. Bivariate correlations among a series of continuous variables

4. In a journal article in your field, find a description of an interaction between two independent variables and a continuous dependent variable.
   a. Critique the description.
   b. If the authors did not include a table or chart to present the net effect of the interaction, create one.
   c. Rewrite the description of the interaction using the “generalization, example, exceptions” (GEE) approach as explained in chapter 13 and appendix A of *Writing about Multivariate Analysis*.

B. APPLYING STATISTICS AND WRITING

1. Using variables from your own data set, run frequency distributions on one nominal, one ordinal, and one interval or ratio variable.
   a. Write a brief description of each distribution, emphasizing the modal value. Summarize, then report key indicators of central tendency.

b. Write a second description of each distribution, this time highlighting a value of interest other than the mean or mode, such as a minority group, unusual value, or most recent value.

2. Using variables from your own data set, calculate one example of each of the following types of bivariate associations. Write a brief description of each pattern, using the principles in chapter 13 of *Writing about Multivariate Analysis*.
   a. An association between two categorical variables
   b. An association between a categorical and a continuous variable
   c. Bivariate correlations among a series of continuous variables

3. Using variables from your own data set, run a three-way association among two categorical independent variables and a continuous dependent variable. Write a description of that association using the GEE approach explained in chapter 13 and appendix A.

4. Using variables from your own data set, run a three-way cross-tabulation of two categorical independent variables and a categorical dependent variable. Write a description of that association using the GEE approach explained in chapter 13 and appendix A.

■ C. REVISING

1. Critique and rewrite descriptions of univariate statistics (distributions, central tendency) from a paper you have written previously, using the criteria in chapter 13.

2. Critique and rewrite descriptions of bivariate statistics (cross-tabulations, differences in means, or correlations) from the same paper, using the criteria in chapter 13.

3. Critique and rewrite a description of a three-way association from a results section you have written previously, using the GEE approach explained in chapter 13 and appendix A.

4. Peer-edit the revised versions of these descriptions.

13 Writing about Distributions and Associations

SOLUTIONS

1. Descriptions of the specified tables and charts.
   a. "Table 5.3 shows the demographic composition of the study sample. Just over half of the 2,058 respondents were female (51.4%). Persons aged 40 to 64 years were the largest single age group in the sample (41.4%), just edging out persons aged 18–39 (37.8%). Elderly persons (aged 65 and older) made up about one-fifth of the sample.

      "The most common racial/ethnic group was non-Hispanic whites, with 2½ times as many respondents as the second largest racial/ethnic group, non-Hispanic blacks (55.6% and 22.1%, respectively). Hispanics comprised the third-largest group (15.9%), followed by Asians (4.2%) and persons of other racial/ethnic origin (2.2%)."

   b. "In 2000 in the United States, human resources comprised by far the largest single category of federal outlays (61% of the $1.8 trillion spent that year; figure 6.2b). The second largest category—national defense—accounted for only about one quarter as much as human resources (16% of the total). Net interest, physical resources, and other functions together comprised the remaining 23% of all outlays."

3. Use the results from Zimmerman (2003) to answer the given questions.
   a. "Among Williams College students with SAT scores in the middle 70%, women's GPAs averaged 0.11 points higher than men's ($p < 0.01$)."
   b. "Among students in the bottom 15% of SAT scores, there was no significant association between roommate's math SAT score and student's college GPA. Although the estimated coefficient suggests a GPA 0.15 points lower if roommate's math SAT were 400 instead of 800, the finding was not statistically significant."

5. In statistical terminology, a situation where the association between one independent variable (mode of interview) and the dependent variable (odds of reporting a sensitive behavior) depends on a second independent variable (type of behavior) is called an interaction or effect modification. In GEE lingo, it is called an exception.
   a. Description of the pattern for a group of first-year high school students: "A recent study in Kenya found that the chances of reporting specific sensitive behaviors such as having had sex with a stranger or being coerced into sex differed depending on how the data were collected (table 6C). For the three most sensitive topics studied, boys were more likely to report having experienced those behaviors if they

were interviewed using a self-administered computer-aided interview than if interviewed in person. On the other hand, they were more likely to report ever having had a girlfriend if interviewed in person than if they completed a computer-aided self-interview."

b. Description of the pattern for a group of graduating statistics majors: "A study by Mensch and colleagues of teenagers in Kenya found that method of data collection and type of sensitive behavior interact in their effect on odds of reporting sensitive behaviors such as having had sex with a stranger or being coerced into sex (table 6C). For the three most sensitive topics studied, the odds of reporting those behaviors were highest among boys interviewed using a self-administered computer-aided interview and lowest among those interviewed in person. In contrast, for the topic "ever having had a girlfriend" the odds were highest among boys interviewed in person and lowest among those completing a computer-aided self-interview."

14 Writing about Multivariate Models

PROBLEM SET

1. Fauth et al. (2004) studied the effects of a residential mobility experiment, comparing outcomes of low-income adults in public housing who moved to low-poverty neighborhoods to those who stayed in their original, high-poverty neighborhoods. "Movers" were chosen by lottery from among those who applied for the program. Their results are summarized in tables 14A (bivariate statistics) and 14B (multivariate model results). Use those data to answer questions 1 through 3.

Table 14A. Individual background characteristics, neighborhood, and housing characteristics of movers and stayers, Yonkers Residential Mobility Program, 1994–1995

	Residential status			
	Movers ($n = 173$)	Stayers ($n = 142$)	Total ($n = 315$)	χ^2 or F[a]
Background characteristics				
Age (mean years)	36.69	34.07	35.51	6.45**
Female	97%	96%	97%	0.41
Latino (ref. = black)	31%	25%	28%	1.07
At least high school education	67%	53%	61%	6.62**
Female household head	76%	85%	80%	4.39*
Mean # children in household	1.72	2.01	1.85	6.04*
Neighborhood/housing				
Danger (3 items)	0.26	1.29	0.72	144.11***
# of victimizations in past year (1 item)	0.12	0.32	0.21	9.21*
Disorder (5 items)	0.15	1.41	0.72	796.17***
Cohesion (4 items)	0.62	0.40	0.52	43.48***
Resources (5 items)	3.05	2.89	2.98	4.90*
Housing quality (5 items)	0.20	0.54	0.35	54.40***

Source: Adapted from Rebecca C. Fauth, Tama Leventhal, and Jeanne Brooks-Gunn, "Short-term Effects of Moving from Public Housing in Poor to Middle-class Neighborhoods on Low-income, Minority Adults' Outcomes," *Social Science and Medicine* 59 (2004): 2271–84, table 1, *http://www.sciencedirect.com/science*.

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

[a] $\chi 2$ statistic reported for difference in categorical variable between movers and stayers; *F*-statistic for difference in continuous variable.

1. Answer the following questions based on the information in table 14A:
   a. Did the random assignment succeed in equalizing the background characteristics of movers and stayers? Write a paragraph summarizing the similarities and differences in background characteristics between those two groups.
   b. Did neighborhood and housing characteristics differ according to residential status (e.g., for movers versus stayers)? Write a paragraph generalizing these findings.
   c. What do these statistics suggest about the need for multivariate models of these outcomes by residential status? Explain your reasoning.

2. Write a paragraph describing the results in table 14A, using the principles in chapter 14 of *Writing about Multivariate Analysis* for building the case for a multivariate model and your answers to question 1.

3. Write a description of the findings in table 14B, using the GEE approach to summarize findings across the six dependent variables, following the guidelines on pages 346–47 of *Writing about Multivariate Analysis*.

Table 14B. Results from OLS models of six neighborhood characteristics and housing quality measures, Yonkers Residential Mobility Program, 1994–1995

	Dependent variable					
Independent variable	Danger	Victimization	Disorder	Cohesion	Resources	Housing quality[a]
Mover	–0.99***	–0.19**	–1.25***	0.21***	0.13	–0.30***
Age (years)	0.01	0.00	0.00	0.00	0.00	0.00
Latino	0.16	0.00	–0.02	–0.01	0.09	–0.19***
High school graduate	0.06	0.07	0.04	0.02	0.05	–0.06
Female headed HH	–0.27*	–0.01	0.02	–0.03	–0.05	0.07
# children in HH	0.05	0.07*	0.05*	–0.01	0.00	0.03
R^2	0.34	0.05	0.73	0.14	0.02	0.20

Source: Adapted from Fauth, Leventhal, and Brooks-Gunn 2004, table 3.

[a] A higher value indicates worse housing quality (e.g., more problems with rats and mice).

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

4. Write a description of Zimmerman's findings (table 14C), focusing on the results for own SAT scores and roommate's SAT scores. Follow the guidelines in chapter 14 about organizing your description. Generalize across the three models to the extent possible: Which results are similar for the three groups and which differ? Why did Zimmerman run three models?

Table 14C. Estimated coefficients and standard errors from a model of cumulative grade point average by own SAT scores and roommate's SAT scores, Williams College classes of 1999–2001

	Student's own combined math & verbal SAT score		
	Lowest 15%	Middle 70%	Top 15%
Own verbal SAT score/100	0.205	0.199	0.118
	(0.039)	(0.015)	(0.055)
Own math SAT score/100	0.065	0.112	0.045
	(0.036)	(0.017)	(0.051)
Race (ref. = white)			
Black	–0.181	–0.386	–0.800
	(0.046)	(0.053)	(0.059)
Hispanic	–0.036	–0.254	–0.050
	(0.059)	(0.046)	(0.274)
Native American	–0.238	0.212	dropped
	(0.169)	(0.168)	
Not a U.S. citizen	0.076	0.126	0.055
	(0.091)	(0.055)	(0.066)
Asian	0.210	–0.065	–0.201
	(0.120)	(0.026)	(0.047)
Female	0.262	0.103	0.107
	(0.038)	(0.016)	(0.028)
Roommate's verbal SAT score/100	0.006 (0.025)	0.043 (0.012)	–0.013 (0.021)
Roommate's math SAT score/100	–0.038 (0.028)	–0.021 (0.012)	0.030 (0.022)
Sample size	450	2,072	629
R^2	0.41	0.27	0.21

Source: Adapted from David A. Zimmerman, "Peer Effects in Academic Outcomes: Evidence from a Natural Experiment," *Review of Economics and Statistics* 85.1 (2003): 9–23, table 4.

Answer questions 5 through 7 based on the results in table 14D from Fussell and Massey (2004).

Table 14D. Estimated log-odds of first trip to the United States, Men, 1987–1998 Mexican Migration Project

	Log-odds	Standard error
Demographic background		
Age (years)	–0.003	0.02
Age-squared	–0.001	0.0002
Ever married	–0.09	0.06
Number of minor children in household	0.01	0.01
Human capital		
Years of education	–0.04	0.006
Months of labor-force experience	–0.002	0.0007
Social capital in the family		
Parent a prior U.S. migrant	0.51	0.05
Siblings prior U.S. migrants	0.36	0.02
Social capital in the community		
Migration prevalence ratio[a]		
0–4	–0.99	0.15
5–9	–0.09	0.12
(10–14)		
15–19	0.35	0.10
20–29	0.57	0.13
30–39	0.95	0.15
40–59	0.74	0.19
60 or more	0.34	0.15
Intercept	–3.31	0.26
– 2 log likelihood	23,369.2	
Df	26	

Source: Adapted from Elizabeth Fussell and Douglas S. Massey, "The Limits to Cumulative Causation: International Migration from Mexican Urban Areas," *Demography* 41.1 (2004): 151–71. Table 2, http://muse.jhu.edu/journals/demography/v041/41.1fussell.pdf.

Note: Model also includes controls for occupational sector, internal migratory experience, community characteristics, and Mexican economic and U.S. policy context.

[a] The migration prevalence ratio = the number of people aged 15+ years who had ever been to the U.S./the number of people aged 15+ years ×100.

5. Write a description of the age pattern of migration to the United States, with reference to the chart you created in question 7a of the problem set to chapter 6.

6. Write a description of the relationship between human capital and migration.

7. Write one to two paragraphs describing the association between social capital in the family and community and migration from Mexico to the United States, with reference to the chart you created in question 7b of the problem set to chapter 6.

14 Writing about Multivariate Models

SUGGESTED COURSE EXTENSIONS

A. REVIEWING

1. Find a journal article about an application of multivariate analysis to a research question in your field. Critique the methods and results sections, using the principles in chapter 14 of *Writing about Multivariate Analysis* to check for the following:
   a. An explanation of why a multivariate model is needed for this research question and data
   b. Topic sentences that introduce the purpose of each table, chart, or quantitative comparison
   c. Identification of the role of each independent variable (e.g., key variable, mediator, confounder)
   d. Descriptions of direction, magnitude, and statistical significance of the association between the key independent variable and the dependent variable
   e. Explanations of how specific numeric findings address the questions under study
   f. Transition sentences that explain how one paragraph follows from the previous paragraph.

2. Find a journal article about an application of multivariate analysis to a topic in your field that involves a series of nested models. Critique the description of the nested model results, using the criteria described under "Comparing a Series of Nested Models" and "GEE Revisited" in *Writing about Multivariate Analysis* (342 and 346, respectively). Rewrite it to correct the flaws you identified in part a.

3. Find a journal article about an application of multivariate analysis to a topic in your field that involves a set of stratified models, such as the same model estimated separately by gender, region, or time period. Critique the description of the stratified model results, using the criteria described under "GEE Revisited" in *Writing about Multivariate Analysis* (346). Rewrite the description to correct the flaws you identified in part a.

B. WRITING

1. Write a description of one or more tables of bivariate results from your own data, using the criteria on pages 322–31 of *Writing about Multivariate Analysis*.

2. Write a description of results of one multivariate model for the same research question as in question B.1, using the criteria listed under question A.1.

3. Write a description of a series of nested models for the same research question as in question B.2, using the criteria described under "Comparing a Series of Nested Models" and "GEE Revisited" in *Writing about Multivariate Analysis* (342 and 346, respectively).

4. Write a description of a set of stratified models for the same research question as in question B.2, using the criteria described under "GEE Revisited" in *Writing about Multivariate Analysis* (346).

C. REVISING

1. Evaluate a description of a single multivariate model from the results section of a paper you have written previously, using the criteria listed under question A.1. Rewrite that description to rectify any problems you identified.

2. Evaluate a description of a series of nested models from the results section of a paper you have written previously, using the criteria described under "Comparing a Series of Nested Models" and "GEE Revisited" in *Writing about Multivariate Analysis* (342 and 346, respectively). Rewrite that description to rectify any problems you identified.

3. Evaluate a description of a set of stratified models from the results section of a paper you have written previously, using the criteria described under "GEE Revisited" in *Writing about Multivariate Analysis* (346). Rewrite that description to rectify any problems you identified.

14

Writing about Multivariate Models

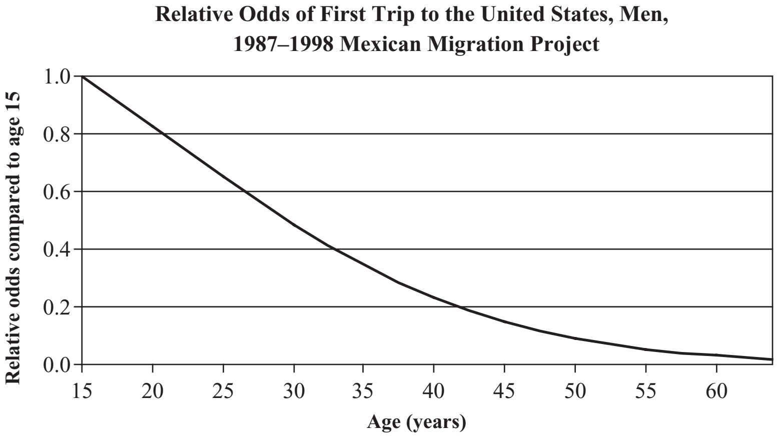
SOLUTIONS

1. Answer questions based on the data in tables 14A and 14B.
   a. No, the random assignment didn't succeed in equalizing the background characteristics of movers and stayers. "Despite random assignment of treatment and control groups in the Yonkers Residential Mobility Program, there were statistically significant differences in four of the six measured background characteristics between participants who moved versus those who stayed in their original neighborhoods (table 14A). Movers were on average slightly older, more likely to have at least a high school education, less likely to be in female-headed households, and had slightly fewer children than stayers (all $p < 0.05$). No differences were observed in terms of race/ethnicity or gender."
   b. Yes, neighborhood and housing characteristics differed according to residential status. "On all six dimensions studied, outcomes were statistically significantly better among movers than stayers (table 14A). Negative outcomes (danger, victimizations, disorder, and indicators of poor housing) were all lower among movers than stayers, while favorable outcomes (cohesion and resources) were higher among movers than stayers."
   c. These bivariate statistics suggest that a multivariate regression is necessary to assess the impact of residential status on the outcomes studied, net of the potentially confounding effect of the background characteristics. All of the observed differences in background characteristics would be expected to favor better outcomes among movers than stayers regardless of where they live. For example, older age, two-parent households, better education, and smaller families are often associated with better resources than younger, female-headed, less-educated, and larger families. Hence a multivariate model is needed to control for those characteristics in order to measure the net effect of moving versus staying.

3. "Table 14B presents results of multivariate models of six measures of neighborhood characteristics and housing quality from the Yonkers Residential Mobility Program. On five of the six outcomes studied, subjects who moved showed statistically significant better outcomes than those who remained in their original neighborhoods, even when the effects of potential confounders were taken into account. The negative outcomes (danger, victimization, disorder, and problems with housing quality) were each lower among movers than stayers, while the favorable out-

comes (cohesion and resources) were higher among movers, though the difference in resources was not statistically significant. Although some of the background control variables were statistically significantly associated with one or two of the outcomes, none showed a consistent pattern of association."

5. "The odds of first migration to the United States declined rapidly between ages 15 and 40, then continued to decline with age, but at a slower rate (figure 6C). For example, the relative odds of migration were roughly 0.60 among 25-year-olds, 0.30 among 35-year-olds, and 0.15 among 45-year-olds when each was compared to 15 year olds."

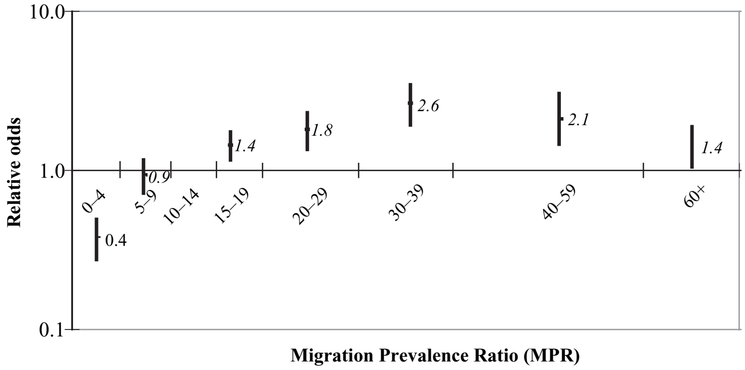


Based on model controlling for marital status, number of children, education, labor force experience, family migrant history, and migration prevalence ratio. Reference category = 15 year olds.

Figure 6C.

7. "Social capital in the family and in the community is an important predictor of odds of migration from Mexico to the United States even when individual demographic background, human capital, and community economic and policy context are taken into account. In terms of family social capital, both having a parent and having a sibling who was a prior U.S. migrant increased the chances of migrating (OR = 1.67 and 1.43, respectively, compared to having no family members as prior U.S. migrants; both $p < 0.001$). In terms of community social capital, odds of migration increased with increasing migration prevalence ratio (MPR) up to an MPR of 40%, then declined slightly among communities with very high MPRs (figure 6D). For example, the odds of migration were nearly seven times as high among men from communities where 30% to 39% of people aged 15 and older had ever been to the U.S. as among those from communities where fewer than 5% had been there."

Relative Odds and 95% Confidence Interval (CI) of First Trip to the United States, by Migration Prevalence Ratio, Men, 1987–1998, Mexican Migration Project



Compared to MPR = 10-14. Based on model controlling for age, marital status, number of children, education, labor force experience, and family migrant history.

Figure 6D.

15 Speaking about Numbers

PROBLEM SET

1. Adapt the material in text box 16.2 (*Writing about Multivariate Analysis,* 402) into slides for a 10-minute presentation to a general audience, including the comments that explain how the material illustrates the principles of how to write about numbers.

2. Write the speaker's notes to accompany the slides you created for the previous question.

3. Create one or more slides to present the following material to a scientific audience. "The Center for Epidemiological Studies-Depression Scale (CES-D) is a 20-item scale for epidemiological research that was developed by the National Institute of Mental Health. Respondents are asked to choose from four possible responses in a Likert format, where '0' is 'rarely or none of the time (less than one day per week),' and '3' is 'almost all or all of the time (five to seven days per week).' The theoretical range is from 0 to 60, with higher scores reflecting greater levels of depressive symptoms. The CES-D has four separate factors: depressive affect, somatic symptoms, positive affect, and interpersonal relations. The CES-D has very good internal consistency with alphas of 0.85 for the general population and 0.90 for a psychiatric population (Radloff 1977)."

4. Adapt the following tables into simpler tables or charts for use on slides for a speech. Aim for one concept or series of closely related concepts per chart. See table 6.1 (*Writing about Multivariate Analysis,* 150) for guidance on which type of chart to use for each topic.
   a. Table 5.1 ("Households by type, race, and Hispanic origin," *Writing about Multivariate Analysis,* 84)
   b. Table 9.2 ("Predicted difference in birth weight by race/ethnicity and mother's educational attainment," ibid., 216).
   c. Table 6B. "Estimated log-odds of first trip to the United States," Fussell and Massey (2004).
   d. Table 10A. "Effect of own SAT scores and roommate's SAT scores on cumulative grade point average, by range of own SAT score," Zimmerman (2003). Create one chart to show how the coefficients on own and roommate's math and verbal SAT scores vary across the models for different levels of combined own SAT score.

5. Write "Vanna White" notes to introduce and explain the following the tables or charts to a scientific audience. Use the GEE approach to summarize the patterns where appropriate:
   a. Figure 6.8 ("Log-odds from competing risks model of reasons for program disenrollment," *Writing about Multivariate Analysis,* 132)
   b. Figure 6.2b ("Federal outlays by function, 2000," ibid., 124)
   c. Figure 6.12 ("Predicted birth weight by race/ethnicity and income-to-poverty ratio," ibid., 138)
   d. Table 7.1. ("Poverty rates [%] by group under current and proposed poverty measures, United States, 1992," ibid., 176)
   e. Table 9.2 ("Predicted difference in birth weight by race/ethnicity and mother's educational attainment," ibid., 216)

6. Practice presenting one table and one chart from question 5, using the Vanna White notes you wrote for that exhibit. Evaluate each of those mini-presentations using the checklist in chapter 15 of *Writing about Multivariate Analysis*. Revise the presentation of each slide to fit within two minutes.

7. Create the following materials for speeches.
   a. Adapt the material in table 14A into a series of chart slides demonstrating why a multivariate model is needed to assess the impact of the Yonkers Residential Mobility Program on neighborhood and housing quality outcomes. Aim for one concept or series of closely related concepts per chart. Include text annotations to describe the patterns.
   b. Adapt the multivariate model results from table 14B into one or two chart slides.
   c. Write speaker's notes for those slides, including Vanna White descriptions of charts, and transition sentences between slides, following the guidelines on pages 372–76 of *Writing about Multivariate Analysis*.

15 Speaking about Numbers

SUGGESTED COURSE EXTENSIONS

A. WRITING

1. Create slides and speaker's notes for a 20-minute presentation of a paper involving a multivariate analysis, to be presented at a professional conference in your field. Include slides for each major section of the paper, including introduction, literature review, data and methods, results (several charts or tables; see question A.2), and conclusions.

2. Adapt charts or tables from your paper to be used on the slides. Write speaker's notes with Vanna White directions for each.

3. Peer-edit the written drafts of slides and notes, using the checklist from chapter 15 of *Writing about Multivariate Analysis*.

4. Ask a test audience to evaluate a live presentation of your talk for your specified audience and allotted time, using the criteria on page 378 of *Writing about Multivariate Analysis*.

5. Make revisions to slides and speaker's notes based on what you learned in your rehearsal.

C. REVISING

1. Critique slides you have created previously for a 15-to-20-minute speech about a multivariate analysis to a scientific audience, using the criteria in chapter 15.

2. Critique the speaker's notes for the same speech.

3. Revise a table of multivariate results from your paper into several simpler table slides or chart slides, with individualized titles that reflect the specific content of each slide.

4. Write Vanna White notes to introduce and explain one table and one chart from your revised presentation.

5. Exchange your revised work from questions C.3 and C.4 with someone working on a different topic and data. Peer-edit each other's work.

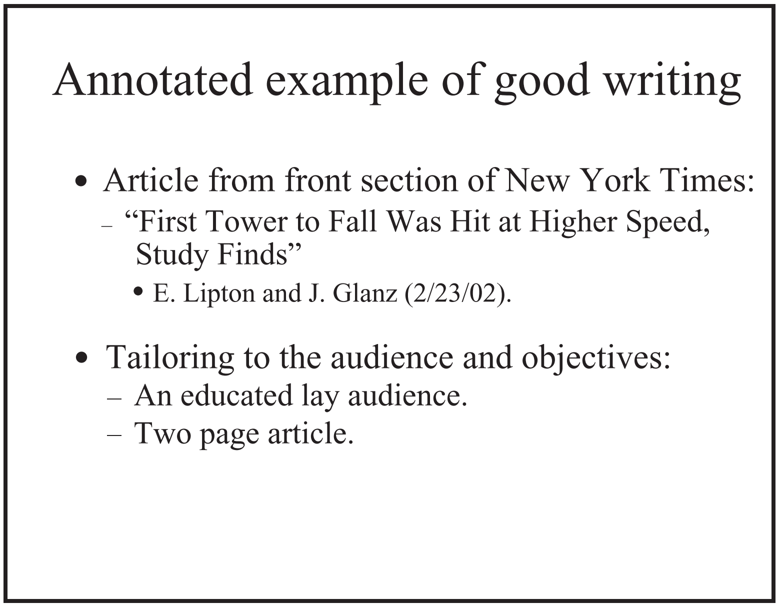
7. Revise the slides to create a 10-minute presentation for a lay audience.

15

Speaking about Numbers

SOLUTIONS

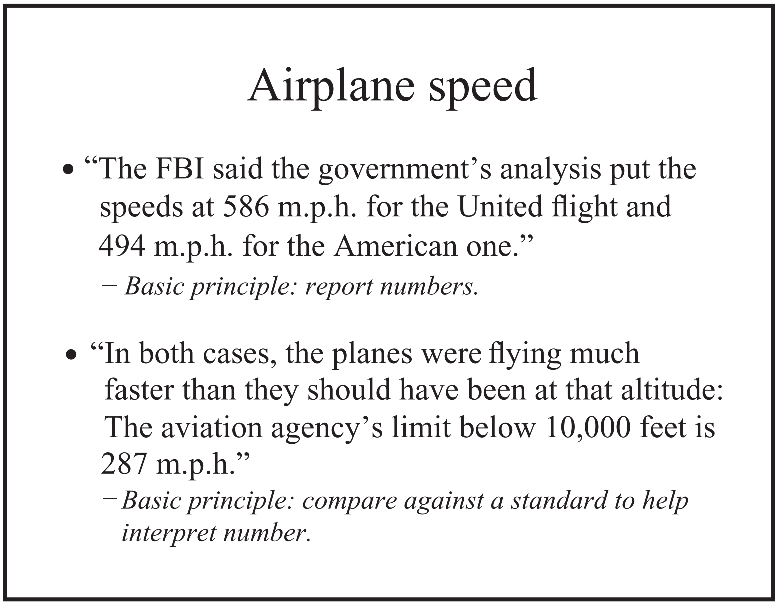
1. Slides for a presentation about the physical impact of the planes on the Twin Towers (box 16.2).



Annotated example of good writing

- Article from front section of New York Times:
  - "First Tower to Fall Was Hit at Higher Speed, Study Finds"
    - E. Lipton and J. Glanz (2/23/02).
- Tailoring to the audience and objectives:
  - An educated lay audience.
  - Two page article.

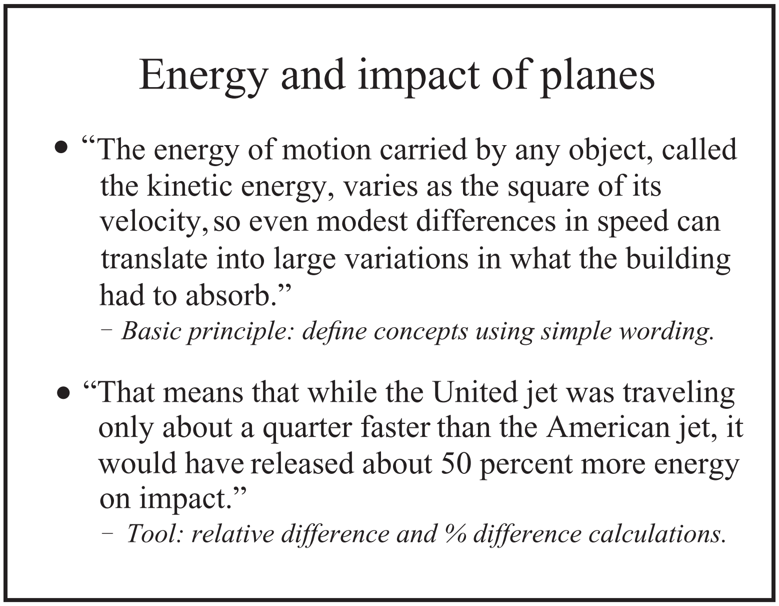
Figure 15A.



Airplane speed

- “The FBI said the government’s analysis put the speeds at 586 m.p.h. for the United flight and 494 m.p.h. for the American one.”
  - *Basic principle: report numbers.*
- “In both cases, the planes were flying much faster than they should have been at that altitude: The aviation agency’s limit below 10,000 feet is 287 m.p.h.”
  - *Basic principle: compare against a standard to help interpret number.*

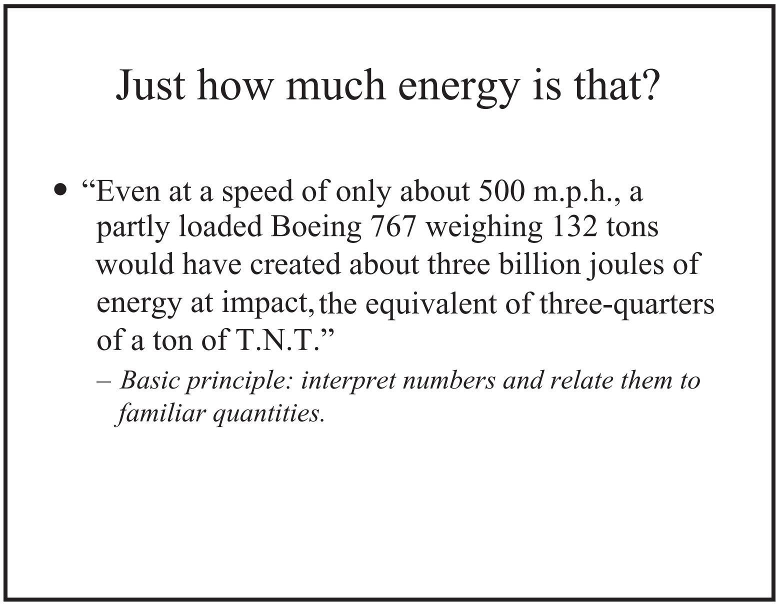
Figure 15B.



Energy and impact of planes

- “The energy of motion carried by any object, called the kinetic energy, varies as the square of its velocity, so even modest differences in speed can translate into large variations in what the building had to absorb.”
  - *Basic principle: define concepts using simple wording.*
- “That means that while the United jet was traveling only about a quarter faster than the American jet, it would have released about 50 percent more energy on impact.”
  - *Tool: relative difference and % difference calculations.*

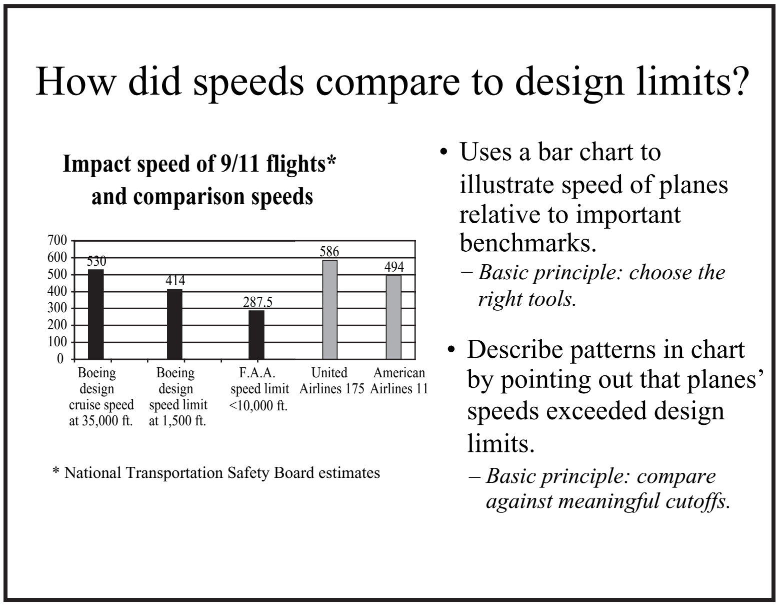
Figure 15C.



Just how much energy is that?

- "Even at a speed of only about 500 m.p.h., a partly loaded Boeing 767 weighing 132 tons would have created about three billion joules of energy at impact, the equivalent of three-quarters of a ton of T.N.T."
  - *– Basic principle: interpret numbers and relate them to familiar quantities.*

Figure 15D.



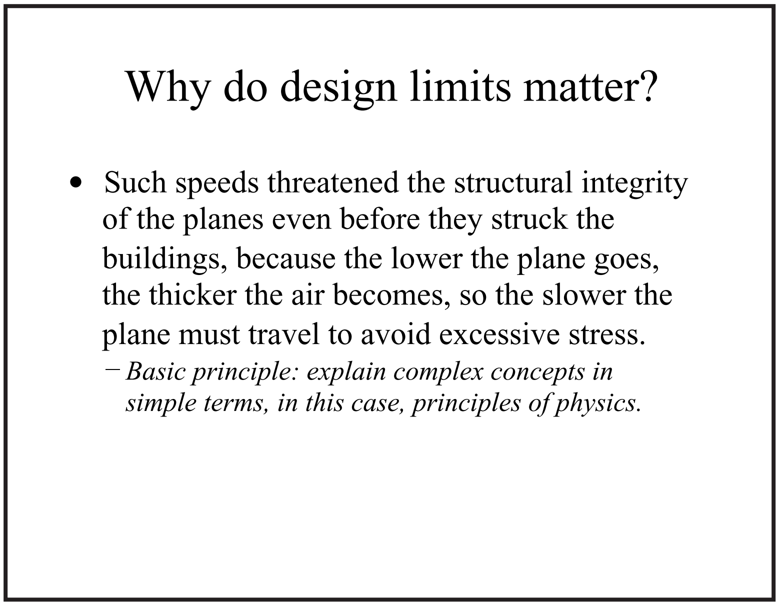
How did speeds compare to design limits?

Impact speed of 9/11 flights* and comparison speeds

* National Transportation Safety Board estimates

- Uses a bar chart to illustrate speed of planes relative to important benchmarks.
  - *– Basic principle: choose the right tools.*
- Describe patterns in chart by pointing out that planes' speeds exceeded design limits.
  - *– Basic principle: compare against meaningful cutoffs.*

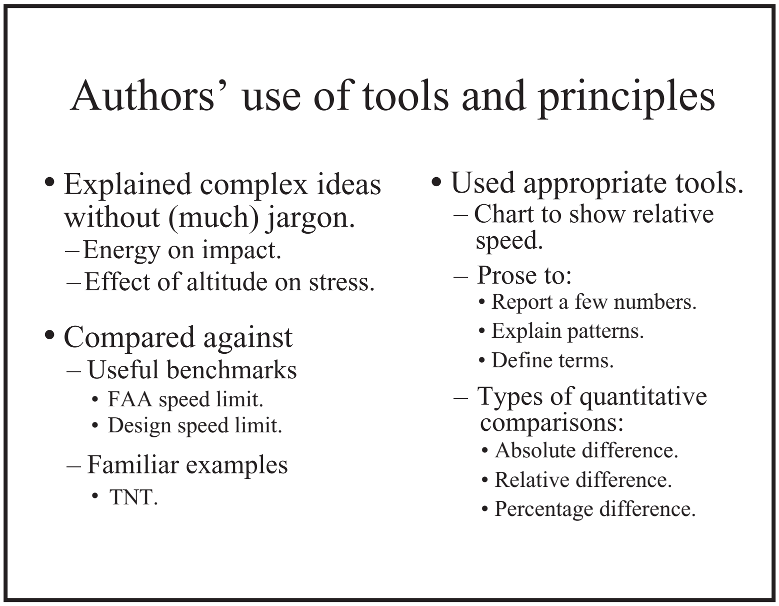
Figure 15E.



Why do design limits matter?

- Such speeds threatened the structural integrity of the planes even before they struck the buildings, because the lower the plane goes, the thicker the air becomes, so the slower the plane must travel to avoid excessive stress.
  - *Basic principle: explain complex concepts in simple terms, in this case, principles of physics.*

Figure 15F.

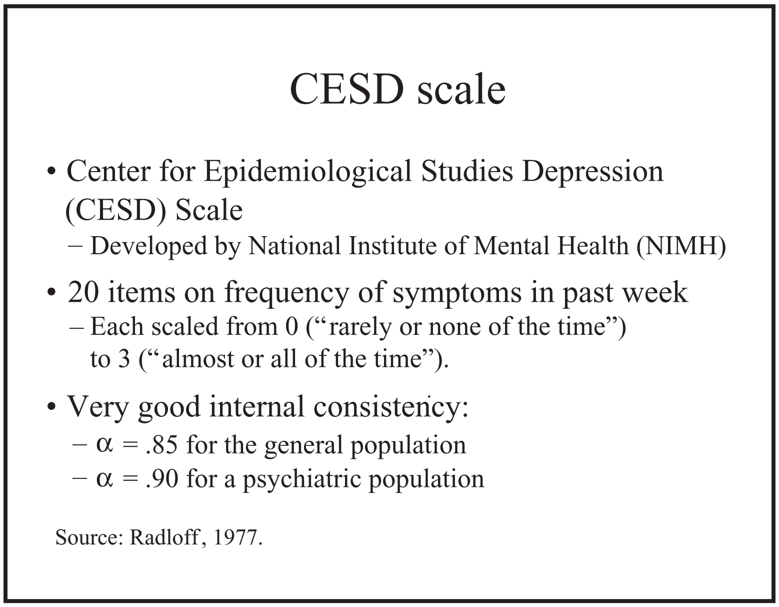


Authors' use of tools and principles

- Explained complex ideas without (much) jargon.
  - Energy on impact.
  - Effect of altitude on stress.
- Compared against
  - Useful benchmarks
    - FAA speed limit.
    - Design speed limit.
  - Familiar examples
    - TNT.
- Used appropriate tools.
  - Chart to show relative speed.
  - Prose to:
    - Report a few numbers.
    - Explain patterns.
    - Define terms.
  - Types of quantitative comparisons:
    - Absolute difference.
    - Relative difference.
    - Percentage difference.

Figure 15G.

3. Slides about data and methods regarding CES-D scale for a scientific audience.

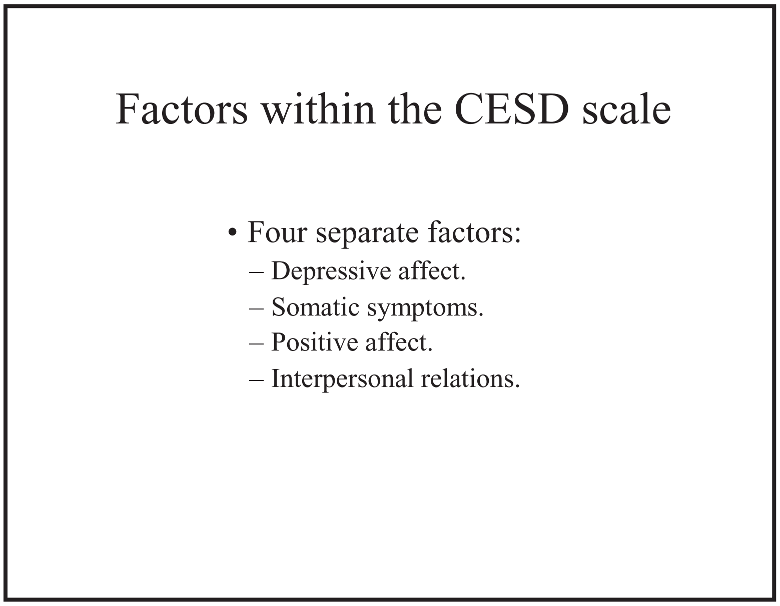


CESD scale

- Center for Epidemiological Studies Depression (CESD) Scale
  - Developed by National Institute of Mental Health (NIMH)
- 20 items on frequency of symptoms in past week
  - Each scaled from 0 (“rarely or none of the time”) to 3 (“almost or all of the time”).
- Very good internal consistency:
  - α = .85 for the general population
  - α = .90 for a psychiatric population

Source: Radloff, 1977.

Figure 15H.



Factors within the CESD scale

- Four separate factors:
  - Depressive affect.
  - Somatic symptoms.
  - Positive affect.
  - Interpersonal relations.

Figure 15I.

5. Vanna White notes, and GEE approach where appropriate
   a. “Figure 6.8 illustrates how the chances of disenrolling from the State Children’s Health Insurance Program vary by reason and demographic factors, based on a set of competing risks models controlling for all variables shown in the chart. Demographic factors are arrayed across the *x* axis [wave horizontally]. Each cluster [point to one] shows how that factor is associated with each of the three possible reasons for disenrollment, with other insurance shown in gray, other government program in white, and nonpayment in black [point at respective bars]. The log-odds of disenrollment are shown on the *y* axis [wave vertically]. Bars that drop below the line at $y = 0.0$ represent lower odds than in the reference category, while those above the line represent higher odds.” (Describe the pattern as in the description of figure 6.8 in chapter 6, *Writing about Multivariate Analysis,* 131–33.)
   b. “The distribution of federal outlays by major function in the United States in 2000 is shown in figure 6.2b. Human resources (the black wedge [point]) comprised by far the largest single category of federal outlays (61% of the $1.8 trillion spent that year). The second largest category—national defense (dotted)—accounted for only about one quarter as much as human resources (16% of the total). Net interest, physical resources, and other functions together amounted for the remaining 23% of total outlays [point to each wedge as you mention its category].”
   c. “The predicted pattern of birth weight by race/ethnicity and income-to-poverty ratio (or “IPR”) is shown in figure 6.12. The results are based on a multivariate model with controls for gender, mother’s age, educational attainment, and smoking status. The *x* axis shows the IPR, ranging from 0 to 4 times the poverty line [wave across horizontal axis]. There are separate lines for each of the racial/ethnic groups—the solid line for non-Hispanic whites, the dotted line with triangles for Mexican Americans, and the dashed line with squares for non-Hispanic blacks [point at each in turn, top to bottom on the left-hand side of the *x* axis]. Predicted birth weight in grams is shown on the *y* axis [wave vertically].

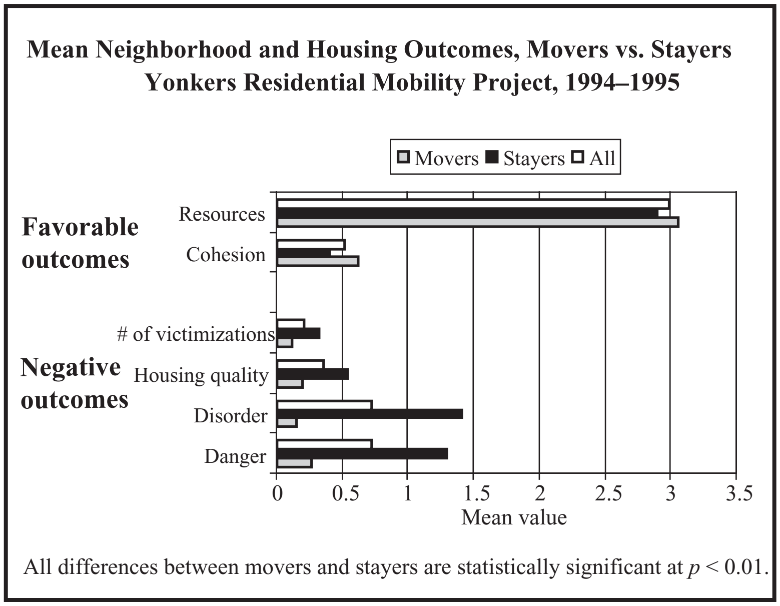
      “Non-Hispanic black infants have considerably lower mean birth weight than the other two groups across the income range [gesture left to right across the line for blacks]. Although Mexican Americans weigh more than whites below the poverty line [gesture from IPR = 0 to 1], for groups with incomes above the poverty line, Mexican Americans weigh less than whites [gesture horizontally at Mexican American line from IPR = 1 to 4].”
   d. “Table 7.1 shows poverty rates for the U.S. in 1992 under different poverty definitions, for the overall population and several age and racial groups in the rows [gesture at the row labels]. The leftmost column of numbers [point to ‘Current’ column label] is the poverty rate under the current poverty definition, while the next two columns to the right [point to ‘Proposed measure’ column labels] show poverty rates under two alternative definitions. The rightmost two columns [point to ‘Percentage point change’ column label] show the percentage point change in the poverty rate between each of the two alternative definitions and the current definition.” [Note: Explain the alternative poverty definitions on a previous slide, as viewers will focus

on the results when presented with the table. Remove the footnote from the slide of this table and turn it into a text slide to precede the table slide.]

"Under either of the proposed alternative definitions, the poverty rate is several percentage points higher than under the current definition. For example, the overall poverty rate would increase by 3.6 points under alternative definition 1 and 4.5 points under alternative definition 2 [point to pertinent cells in 'Total population' row]. Differences for some subgroups are quite small. For example, the poverty rate for the elderly would be projected to increase by only 1.7 percentage points under alternative 1. For other groups, such as Hispanics, the projected increases are considerably larger: 10.6 points [point to pertinent cell]."

e. "Table 9.2 shows the predicted differences in birth weight by race/ethnicity and mother's educational attainment based on the results of model B in table 9.1. Racial/ethnic groups are arrayed in the columns [name them and point to associated columns in turn], and educational attainment is shown in increasing order in the rows [name them and gesture down the rows]. The number in each cell shows the difference in predicted birth weight (grams) between the pertinent group and non-Hispanic whites with at least some college, which is the reference category from the multivariate model." (Describe the pattern as in statement 2 of box 14.2b, *Writing about Multivariate Analysis,* 339.)

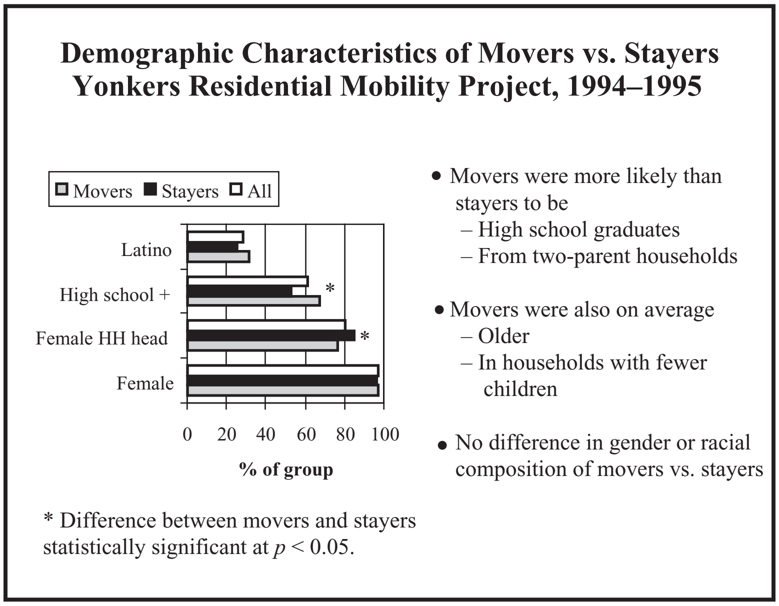
7. Slides to present results of Yonkers Residential Mobility Program evaluation (Fauth et al. 2004).
   a. Slides demonstrating why a multivariate model is needed.



Mean Neighborhood and Housing Outcomes, Movers vs. Stayers
Yonkers Residential Mobility Project, 1994–1995

All differences between movers and stayers are statistically significant at $p < 0.01$.

Figure 15J.

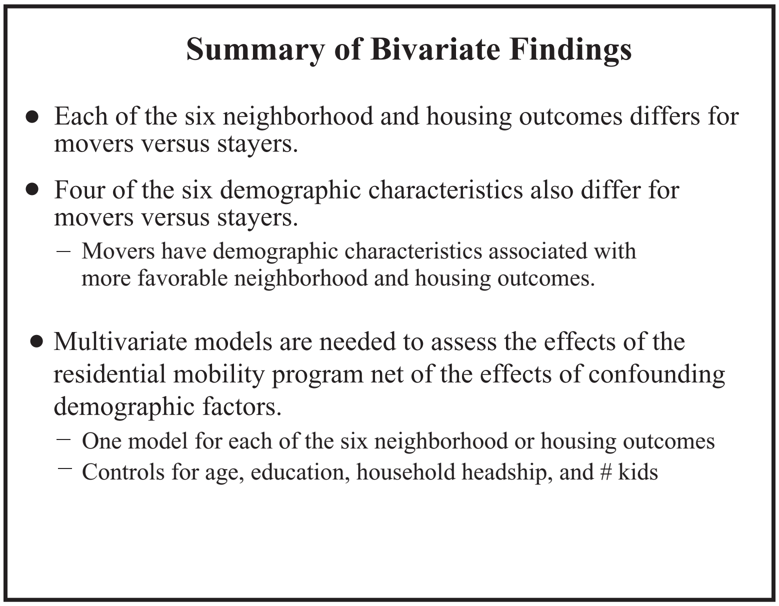


Demographic Characteristics of Movers vs. Stayers
Yonkers Residential Mobility Project, 1994–1995

- Movers were more likely than stayers to be
  - High school graduates
  - From two-parent households
- Movers were also on average
  - Older
  - In households with fewer children
- No difference in gender or racial composition of movers vs. stayers

* Difference between movers and stayers statistically significant at $p < 0.05$.

Figure 15K.

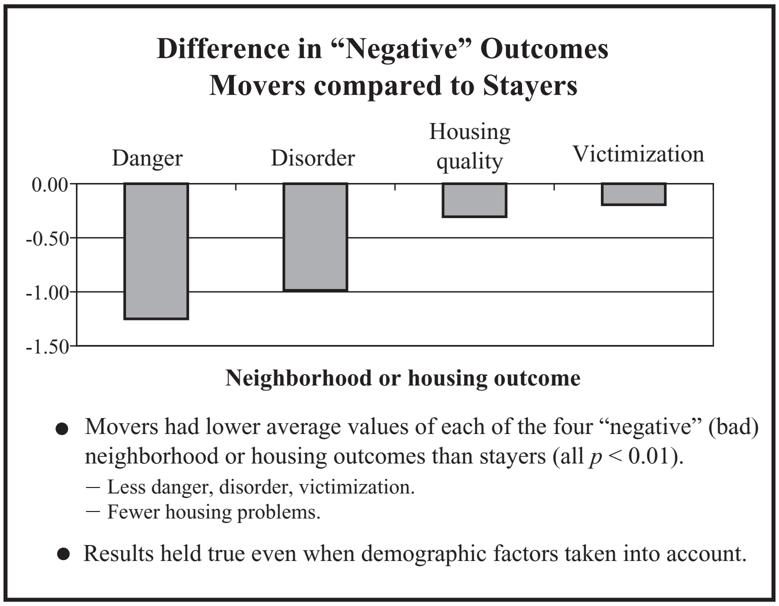


Summary of Bivariate Findings

- Each of the six neighborhood and housing outcomes differs for movers versus stayers.
- Four of the six demographic characteristics also differ for movers versus stayers.
  - Movers have demographic characteristics associated with more favorable neighborhood and housing outcomes.
- Multivariate models are needed to assess the effects of the residential mobility program net of the effects of confounding demographic factors.
  - One model for each of the six neighborhood or housing outcomes
  - Controls for age, education, household headship, and # kids

Figure 15L.

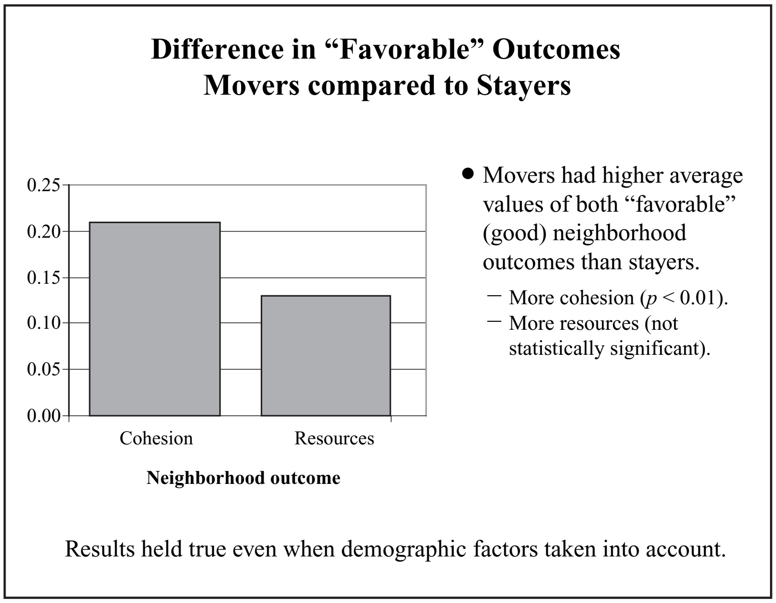
7b. Slides presenting multivariate model results.



Difference in "Negative" Outcomes
Movers compared to Stayers

- Movers had lower average values of each of the four "negative" (bad) neighborhood or housing outcomes than stayers (all $p < 0.01$).
  - Less danger, disorder, victimization.
  - Fewer housing problems.
- Results held true even when demographic factors taken into account.

Figure 15M.



Difference in "Favorable" Outcomes
Movers compared to Stayers

- Movers had higher average values of both "favorable" (good) neighborhood outcomes than stayers.
  - More cohesion ($p < 0.01$).
  - More resources (not statistically significant).

Results held true even when demographic factors taken into account.

Figure 15N.

c. "Figure 15J shows mean values of six different measures of neighborhood and housing quality for low-income families who moved to low-poverty neighborhoods versus those who stayed in high-poverty neighborhoods. In all six dimensions studied, outcomes were statistically significantly better among movers (the gray bars) than among stayers (the black bars). Favorable outcomes (cohesion and resources) [gesture at top two clusters on the chart] were higher among movers than stayers, whereas negative outcomes (danger, victimizations, disorder, and indicators of poor housing) [gesture at four bottom clusters on the chart] were all lower among movers than stayers.

"However, it is important to consider whether differences in demographic characteristics might explain some of the observed differences in these outcomes. Although participants in the Yonkers Residential Mobility Program were randomly assigned to be movers or stayers, some differences in these characteristics are possible. In figure 15K, we see that four of the six background characteristics are more auspicious among movers than stayers. Movers were more likely to be from two-parent households and to have completed high school [point to respective clusters on chart]. They were also on average older and had fewer children in the household.

"[Transition to slide 15L] These bivariate statistics suggest that multivariate models are needed to assess the impact of residential status on each of the outcomes, net of the potentially confounding effect of the background characteristics. All of the observed differences in background characteristics would be expected to favor better outcomes among movers than stayers regardless of residence. For example, older age, two-parent households, better education, and smaller families are often associated with better resources than younger, female-headed, less-educated, and larger families. Hence multivariate models are needed to control for those characteristics.

"Figure 15M shows results of multivariate models of the four negative measures of neighborhood characteristics and housing quality studied as part of the Yonkers Residential Mobility Program (danger, victimization, disorder, and problems with housing quality) [point to respective bars]. Even when the effects of potential confounders were taken into account, subjects who moved had statistically significant better values of each of these four outcomes than those who remained in their original neighborhoods. Put differently, movers experienced less danger, victimization, disorder, and housing problems than stayers.

"Figure 15N shows the results of multivariate models of the two favorable outcomes (cohesion and resources). Both were higher (better) among movers [gesture along *y* axis], but the difference in resources was not statistically significant. Although some of the background control variables were statistically significantly associated with one or two of the outcomes, none showed a consistent pattern of association."

16 Writing for Applied Audiences

PROBLEM SET

1. Write the following components of a two-page policy brief about the study by Fauth et al. (2004), using the information in tables 12A and 14B. It may be helpful to obtain a copy of the complete article, which is available online. (See table notes for reference.)
   a. A title.
   b. One or two simplified tables or charts to summarize their key results. Hint: Use some of the figures you created for question 7 of the problem set to chapter 15.
   c. Short descriptions of each table or chart from part b of this question.
   d. Paragraphs explaining how the findings apply to at least two sets of stakeholders.
   e. A sidebar describing the study methods.

2. Using the information in table 6B, design chartbook pages to present the results of the analysis by Fussell and Massey (2004) to an applied audience. Adapt the charts you created for question 7 in the problem set to chapter 6, and design other charts to illustrate the remaining results. It may be helpful to obtain a copy of the complete article, which is available online. (See table notes for reference.)

Answer questions 3 and 4 using the information in boxes 11.1, 11.2, 12.1, 12.2, 14.1b and 14.2b (*Writing about Multivariate Analysis,* 261, 266, 288, 295, 327, 339).

3. Design a research poster about the birth weight study for an applied audience. Sketch the poster layout and provide notes about the contents of each page, adapting them from the tables, charts, slides, and text boxes from *Writing about Multivariate Analysis*.

4. Write a one-page general-interest article about the birth weight study.

5. Write an executive summary of the study by Zimmerman about peer effects on academic outcomes (2003).

6. Outline a descriptive report about the Zimmerman study for a lay audience.
   a. Write the section headings—one for each major question or topic covered in that study.
   b. Adapt table 10A into simplified tables or charts, each of which focuses on one finding or set of related findings. Write the titles for the charts or tables that would go in each section of the report.

16

Writing for Applied Audiences

SUGGESTED COURSE EXTENSIONS

■ A. REVIEWING

1. Find a poster related to your interests at a professional conference in your field. Discuss the research project with the poster's author. After you return, write a critique evaluating the following, using the criteria on pages 390–94 of *Writing about Multivariate Analysis*:
   a. Title of the poster
   b. Ease of understanding of data and methods description for
      i. researchers in your field
      ii. nonstatisticians
   c. Accessibility of research findings to
      i. researchers in your field
      ii. nonstatisticians
   d. Relevance of conclusions for an applied audience
   e. Clarity of the overall story line on the poster
   f. Poster layout
   g. Type size and other formatting
   h. Availability and quality of handouts
   i. Length and clarity of the presenter's oral description of the poster contents

2. Find an issue brief or policy brief related to a research topic in your field or at a Web site such as the Urban Institute (*http://www.urban.org*). Critique the following elements of the brief, using the guidelines on pages 395–98 of *Writing about Multivariate Analysis*:
   a. Ease of understanding for nonstatisticians
   b. Simplicity of tables and charts
   c. Appropriateness of vocabulary for the intended audience
   d. Layout

3. Find a chartbook about a research topic in your field or at a Web site such as the U.S. Social Security Administration (*http://www.ssa.gov/policy/docs/chartbooks/*) or Healthy People 2010 (*http://www.healthypeople.gov/*). Critique it using the criteria in chapter 16.

4. Find a descriptive report about a topic in your field or at a Web site such as the Office of Human Services Policy (*http://www.aspe.hhs.gov/hsp/indicators03/*). Critique it using the criteria in chapter 16.

5. In the popular press, find a general-interest article about a technical topic. Critique it using the criteria in chapter 16.

B. WRITING

1. Create a 4′ by 8″ poster about a research paper for a conference of your professional association.
   a. Design pages for each major section of the paper, including an introduction, literature review, data and methods, results (several charts or tables; see question B2 below), and conclusions.
   b. Draft the layout of the poster, including space for a title banner and abstract as well as the pages from part a of this question.

2. Adapt charts or tables from your paper to be used on the poster. Write titles and Vanna White notes for each table or chart.

3. Write a narrative to accompany your poster. Include short modules for each of the following.
   a. An introduction to your topic and project
   b. The key findings of your study
   c. The policy or program implications of your work
   d. The research implications of your work
   e. A description of the data used in your analysis
   f. An explanation of your methods for someone familiar with multivariate statistics
   g. An explanation of your methods for nonstatisticians

4. Create handouts
   a. For a statistical audience
   b. For an applied audience

5. Critique and revise the poster, narrative, and handouts.
   a. Ask a colleague to evaluate your poster and associated narrative and handouts, given your specified audience and using the criteria on pages 390–94 of *Writing about Multivariate Analysis*.
   b. Revise the poster, narrative, and handouts based on what you learned in your rehearsal.

6. Write a two-page issue brief about a multivariate analysis, following the guidelines on pages 395–98 of *Writing about Multivariate Analysis*.

7. Write a two- or three-page general-interest article about the purpose, findings, and implications of your multivariate analysis, following the guidelines in chapter 16.

8. Write a chartbook about a multivariate analysis, following the guidelines in chapter 16.

9. Repeat questions A.1 through A.5 from the suggested course extensions to chapter 15, writing a ten-minute oral presentation to a lay audience.

C. REVISING

1. Critique a poster you have created previously for an applied audience about an application of a multivariate analysis, using the criteria on pages 390–94 of *Writing about Multivariate Analysis*. Revise the poster to rectify any problems you identified.

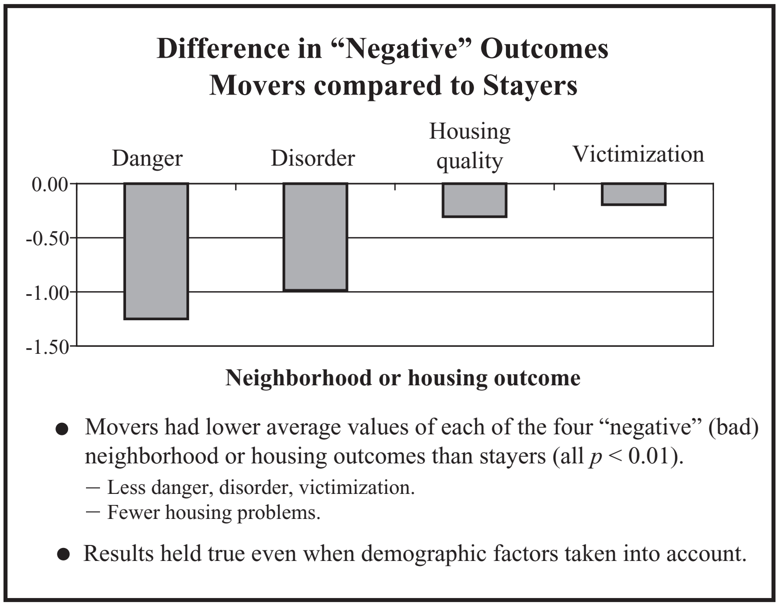
2. Critique a report you have written previously for an applied audience about an application of a multivariate analysis, using the criteria in chapter 16. Revise it to rectify any problems you identified.

3. Critique a speech you have written previously for an applied audience about an application of a multivariate analysis, using the criteria in chapters 15 and 16. Revise it to rectify any problems you identified.

16 Writing for Applied Audiences

SOLUTIONS

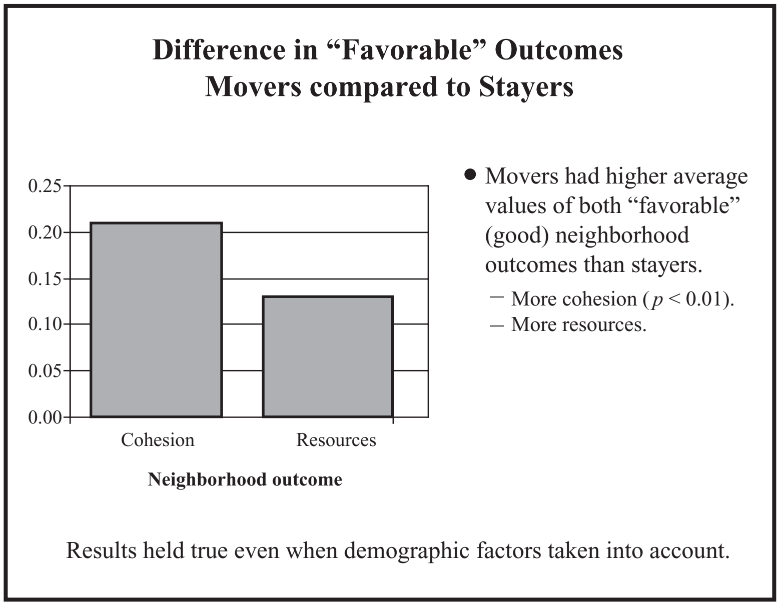
1. Write the specified components of a two-page policy brief.
   a. Title: “Moving to Low-poverty Areas Improves Outcomes for Families in Public Housing”
   b. Charts of key results; same as figures 15M and 15N.



Difference in “Negative” Outcomes
Movers compared to Stayers

- Movers had lower average values of each of the four “negative” (bad) neighborhood or housing outcomes than stayers (all $p < 0.01$).
  - Less danger, disorder, victimization.
  - Fewer housing problems.
- Results held true even when demographic factors taken into account.

Figure 16A.



Difference in "Favorable" Outcomes Movers compared to Stayers

- Movers had higher average values of both "favorable" (good) neighborhood outcomes than stayers.
  - More cohesion ($p < 0.01$).
  - More resources.

Results held true even when demographic factors taken into account.

Figure 16B.

c. "As shown in figure 16A, low-income families who moved into low-poverty neighborhoods showed appreciably lower levels of danger, victimization, disorder, and housing problems than those who remained in their original, high-poverty neighborhoods, even when demographic characteristics were taken into account. Likewise, the favorable outcomes were better among movers than stayers, with higher levels of cohesion and resources (figure 16B)."

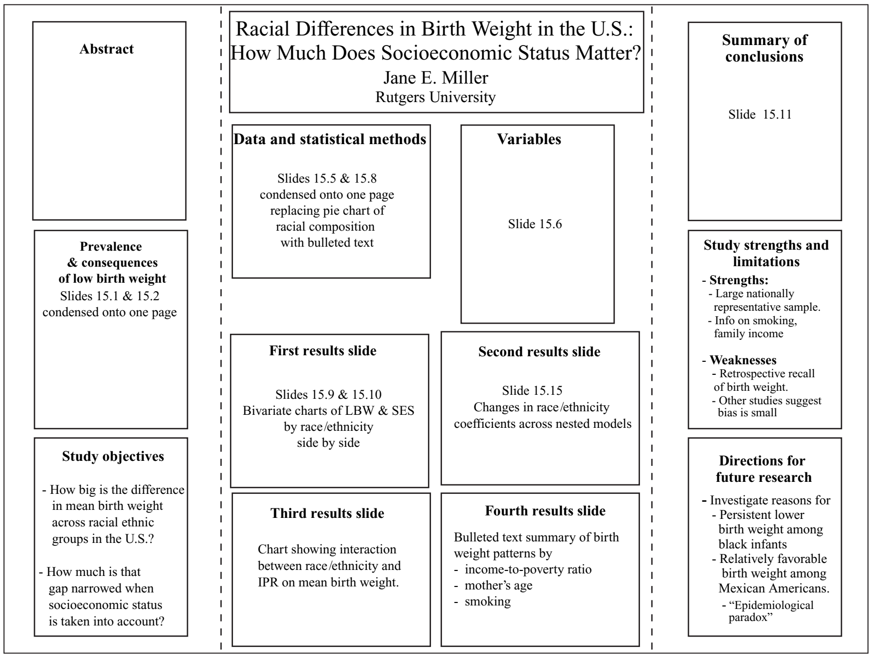
d. "Low-income residents of public housing should advocate for more public housing in low-poverty neighborhoods, and should apply for such benefits when they are available.

   "Housing experts are in the best position to organize grassroots efforts to identify locations for public housing in low-poverty areas, and to enroll eligible persons in those programs. They should lobby for additional public housing in low-poverty areas and should disseminate information about available opportunities to low-income families who are eligible for such housing.

   "Policymakers are in the best position to develop legislation on these topics and to seek funding to support public housing. They should support legislation to fund and maintain public housing in low-poverty areas."

e. Sidebar: In the Yonkers Residential Mobility Program, low-income residents of public housing were randomly assigned to either move to a low-poverty neighborhood or stay in their current high-poverty neighborhood. The statistical analyses shown here correct for slightly more favorable age, educational attainment, and household composition among movers than among stayers.

3. Design a research poster.



Abstract

Prevalence
& consequences
of low birth weight
Slides 15.1 & 15.2
condensed onto one page

Study objectives

- How big is the difference in mean birth weight across racial ethnic groups in the U.S.?
- How much is that gap narrowed when socioeconomic status is taken into account?

Racial Differences in Birth Weight in the U.S.:
How Much Does Socioeconomic Status Matter?
Jane E. Miller
Rutgers University

Data and statistical methods

Slides 15.5 & 15.8
condensed onto one page
replacing pie chart of
racial composition
with bulleted text

Variables

Slide 15.6

First results slide

Slides 15.9 & 15.10
Bivariate charts of LBW & SES
by race/ethnicity
side by side

Second results slide

Slide 15.15
Changes in race/ethnicity
coefficients across nested models

Third results slide

Chart showing interaction
between race/ethnicity and
IPR on mean birth weight.

Fourth results slide

Bulleted text summary of birth weight patterns by
- income-to-poverty ratio
- mother's age
- smoking

Summary of conclusions

Slide 15.11

Study strengths and limitations

- **Strengths:**
  - Large nationally representative sample.
  - Info on smoking, family income
- **Weaknesses**
  - Retrospective recall of birth weight.
  - Other studies suggest bias is small

Directions for future research

- Investigate reasons for
  - Persistent lower birth weight among black infants
  - Relatively favorable birth weight among Mexican Americans.
    - "Epidemiological paradox"

Figure 16C.

5. Executive summary of the study by Zimmerman (2003)

Background

- Peer effects have been observed in many issues related to higher education.
- Students' attitudes, values, and academic performance may be affected by peers.

Study Objectives

- To measure peer effects on academic performance, taking into account other possible determinants such as demographic attributes.

Data and Methods

- Data are from 3,151 students from the Williams College classes of 1990 through 2001.
- Information was collected on student's own math and verbal SAT scores, roommate's math and verbal SAT scores, student's grade point averages (GPA), and roommate matching preferences for freshman year.
- Multivariate regression was used to estimate association between own and roommate's SAT scores on GPA, taking into account gender, race, class year, and type of major.
- Models were estimated for all students combined and separately for students with combined SAT scores in the bottom 15%, middle 70%, and top 15% of the class.

Key Findings

- Mean combined (verbal + math) SAT score for the study sample was 1,396 points, with a standard deviation of 123.
- Students' own SAT scores were positively associated with cumulative GPA at all levels of combined SAT scores. Effects were smaller for math (less than one-tenth of a point increase in GPA per 100-point rise in math SAT) than verbal scores (one-tenth to two-tenths of a point increase in GPA per 100-point rise in verbal SAT).
- Roommate's SAT scores were associated with student's GPA, but the effect was statistically significant only in the middle 70% of the SAT range.
- Roommate's verbal SAT had a modest positive effect on student's GPA—equivalent to a rise of four-hundredths (0.04) of a grade point per 100-point increase in roommate's verbal SAT.
- In contrast, roommate's math SAT had a small negative effect on student's GPA—equivalent to a drop of two-hundredths (–0.02) of a grade point per 100-point increase in roommate's math SAT.

Conclusions

- Peer effects on grade point average appear to be minimal, at least in the context of an elite, four-year private college.