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ABSTRACT

The purpose of this study guide, designed for computer students who have never been involved in a research project, practicum, or dissertation activity, is to provide background information on the affective and cognitive skills required for success in any project involving research and/or statistics. Successful enrollment in computer based learning and the ability to work online are the only prerequisites for this course. Prior experience in a research project may be helpful, but such involvement is not required. Instructions on what to do and how the tasks should be composed are provided for each task. Students are advised to maintain electronic and telephonic contact with the instructor throughout the course. Contents of this study guide are divided into three assignments: (1) Assignment A--Defining the Term Research, Effect of Ethics on Research, Problem Identification, Hypothesis/Objective Development, Literature Review, Research Methodology, Assumptions and Limitations, Data Collection, Data Analysis, Presentation of Results, and Research Summary; (2) Assignment B--Statistical Analyses: Calculation and Interpretation Topical Issues such as Types of Research, Research Designs, Sampling, Test Development, and Levels of Quantitative Description; and (3) Assignment C--final assignment, which involves students in the "mechanics" of statistical analysis. (Contains 15 references.) (ALF)

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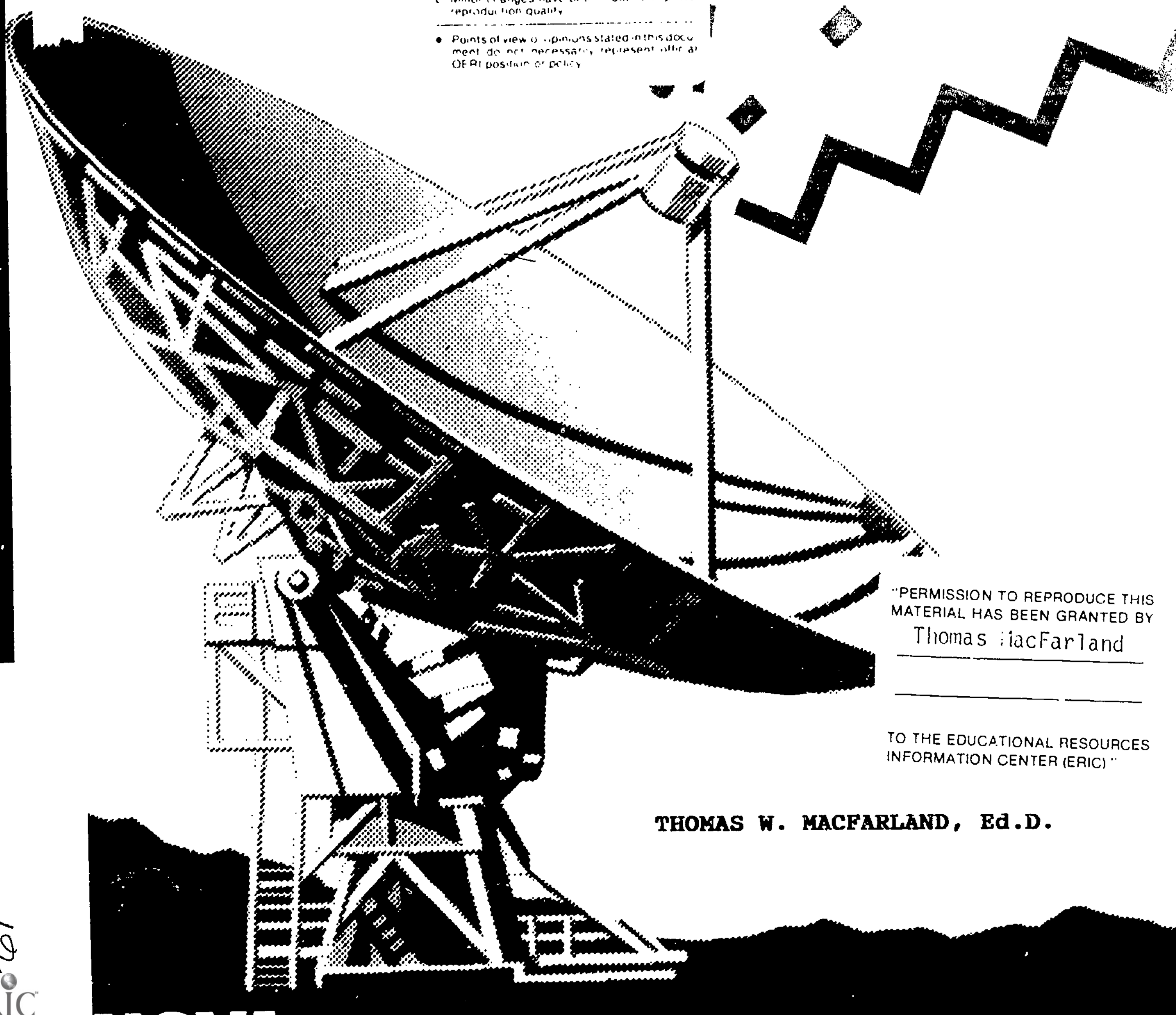

THOMAS W. MACFARLAND, Ed.D.

NOVA

COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

STUDY GUIDE

Electronic Cluster

January 01 to June 30, 1990

Thomas W. MacFarland, Ed.D.

Nova University

Center for Computer and Information Sciences

Fort Lauderdale, Florida 33314

COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

STUDY GUIDE

Purpose

The purpose of this study guide is to provide background information on the affective and cognitive skills required for success in any project involving research and/or statistics.

Orientation

It is recognized that many CCIS/CBL students have never been involved in a research project that would serve as an advance organizer for MOE, practicum, or dissertation activity. This study guide is designed to serve as that introduction to the world of research and statistics.

Prerequisites

Successful enrollment in CBL and the ability to work online are the only prerequisites for this course. Prior experience in a research project may be helpful, but such involvement is not required.

Overall Instructions

The study guide and required readings should be thoroughly reviewed before assignments are attempted. Students should also maintain electronic and telephonic contact with the instructor.

Detailed Instructions

Instructions on "what to do" and "how the tasks should be composed" are provided for each task.

Objectives

At the completion of this course, each student will be able to:

1. Define the term "research" in view of their specific profession.

2. Identify how ethical considerations affect the research process.

3. Use the basic skills associated with internal/external environmental scanning to identify a problem of appropriate scope.

4. Based upon the results of problem identification, develop a tenable research hypothesis and/or research objectives.

5. Use all available sources to review the work (e.g., literature) of other professionals relating to strategies on how to investigate and report on the previously identified problem.

6. Identify the methodology (i.e., procedures, sequential activities) associated with a study in a way so that a peer could

either replicate the study or complete the study if the original researcher was unable to complete the project.

7. Identify the basic assumptions and limitations associated with a research study.

8. Collect data in a manner consistent with previously identified procedures.

9. Analyze data in a manner appropriate to the problem, constraints, and need for precision and accuracy of judgment. (Data analysis will be based on SPSS-X Release 3.0 for VAX/ UNIX).

10. Present the results of a research study in an unbiased manner.

11. Synthesize research results into an organized summary with extended discussion centering upon analysis of observations, implications associated with the findings, and recommendations for the improvement of practice.

Review Questions

Think about how you would respond to the following before you submit Assignments A, B, C, and the MOE:

01. Does your job involve research? Should your job involve research? Would you be better at your profession if you were able to document the results of an accepted research study?

02. Are there ethical considerations in your workplace or profession that limit your involvement in research? Are there research issues in your world of work that remain unresolved

because of fear over ethical issues? Is the issue of ethics in research given consideration by you and your colleagues?

03. Do you know how to identify a problem with scope cognate to your position?

04. Can you identify a "workable" or tenable research hypothesis? Are you sure that you even know what a research hypothesis is? Can you distinguish between a research hypothesis and a research objective? Do you know when it is more appropriate to develop a research objective instead of a research hypothesis?

05. Are you able to use "information age" tools to review the work of others? Do you see why it is important to consult the literature, or do you instead feel that this is merely an academic exercise with no true value or application to your workplace?

06. If you were involved in a research study, do you see why it is vitally important to identify the methodology associated with the study? When you read a research report, do you give special attention to the methodology section, or do you go immediately to the summary section? Do you see that the methodology section of a research study is the area most vulnerable to criticism (i.e., attack) by those who may disagree with the results and subsequent interpretation of results?

07. Do you know why it is important to identify the assumptions and limitations of a research study? Do you feel that statistical analysis that depends upon the notion of random

selection is valid if it is identified in the limitations section that the research sample consisted of an intact cohort of volunteers?

08. What types of data are typical to your profession (e.g., student scores on a standardized test, number of library cards issued each week, government satisfaction with mandated training programs, average load factor on multiuser communications network)? Are there data in your workplace that are ignored simply because they are not recognized as a valuable source of information? Do you see that data are by no means only "numbers" or other conveniently measured phenomena? Did you know that data is plural and datum is singular (e.g., data ... are; datum ... is)?

09. What degree of precision do you need to analyze data? Is it necessary to analyze each datum that you can possibly collect? Are you acquainted with the concept of data reduction and how a well-composed (but succinct) data presentation will have greater effect than a massive report that remains ineffective due to a lack of interest and readership? If you have "numeric" data, are you able to synthesize relationships and trends associated with the data into the form of an easily understood table? Do you see how even "non-numeric" data can be effectively presented in tabular format?

10. Can you present the results of a research study in an unbiased manner? When you document findings, do you let your opinions, bias, and feelings influence what you report? What

value would you place on a research report that was painfully lacking in objectivity?

11. Are you able to synthesize research results into an effective argument? If leadership is perceived as the ability to influence behavior, are you able to write the summary section to a research report that is a demonstration of leadership (i.e., your statements will influence others to bring about desired change)?

Please remember, these questions are not part of the assigned tasks. They are instead offered as an advance organizer to the many issues you will examine in this course. It is hoped, however, that you would be able to effectively answer each question by the time you complete Computer-Based Research and Statistics (IS 7100 and the cognate MOE).

COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT A

Electronic Cluster

January 01 to June 30, 1990

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COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT A

Define the Term "Research"

First, it should be clarified that research is by no means restricted to statistical analysis (although statistical analysis may indeed be a central feature to many research investigations). Instead, research should be viewed as the orderly investigation, analysis, and interpretation of a problem.

To be even more precise, Isaac and Michael (1981:41) identified nine types of research:

A. Historical
B. Descriptive
C. Developmental
D. Case or Field
E. Correlational
F. Causal-Comparative
G. True Experimental
H. Quasi-Experimental
I. Action

In many ways, the exact type of research design used is a matter of definition--we tend to use research methodologies that best "fit" our conceptualization of research. Even so, students should recall that there are many types of research and that each type of research has appropriate uses for the investigation of technically-oriented issues.

TASK A.01

01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 2-3, 41- 58

02. Review objective 01.

03. Provide an operational definition of the term "research." Be sure to defend your definition. You may wish to consult with your colleagues to see how an operational definition can be idiosyncratic.

04. Because of the required defense, this task will likely require two or three paragraphs of narrative description.

TASK A.02

01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 2-3, 41-58

02. Review objective 01.

03. Provide a brief (three to five-paragraph) annotation of the concepts identified in the reading assignment. Please be sure to give special attention to the notion that there are many different types of research designs. By no means should you perceive research only as a statistically-oriented exercise.

TASK A.03

01. Consider the following:

Research, as it is presently practiced in the United States, is largely an extension of the European development of the scientific method.

02. Review objective 01.

03. Briefly address the following rhetorical questions. It is possible that each question could be sufficiently addressed by a one or two-paragraph response.

A. Eurocentric scientific methodology demands the measurement of all phenomena. How would you attempt to measure a phenomenon that cannot be easily measured (e.g., opinions, attitudes)?

B. Is it possible that phenomena that cannot be easily measured are given less attention simply because of the difficulty associated with their measurement?

C. What are a few outcomes that could possibly result from the analysis of only easily measured phenomena?

TASK A.04

01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 41-58

02. Review objective 01.

03. Identify a "problem" at your place of work (e.g., dropout rate of at risk students; theft and/or non-return of library materials; computer-assisted simulation does not bring about expected results; programming teams constantly do not meet project deadlines).

04. Briefly (one or two paragraphs for each) describe how the problem could be addressed by following:

A. Descriptive research methodology

B. Case and field study research methodology

C. True experimental research methodology

Note. The emphasis of this task is on awareness of the difficulty of of control.

The Effect of Ethics on Research

It is recognized that students in Nova University's Center for Computer and Information Sciences are from many different professions and places of work. One of the strengths of the CCIS is the diversity of the student body. As diverse as the student body may be, a common element among all students in the CCIS is that ultimately the research activities of students in the Center for Computer and Information Sciences should have improvement of the "human condition" as an ultimate goal. With this in mind, students in the CCIS (and other researchers) should constantly be aware of the American Psychological Association's Code of Ethics regarding research and experimentation (AMERICAN PSYCHOLOGIST, 1981, 36, 633-638; Best, 1981:84-86; Anastasi, 1982:626-636):

A. Informed consent--subjects have the right to participate or decline participation in a research study without fear of punitive action.

B. Invasion of privacy--subjects have the right to know that their actions are being observed and/or measured. "Secrecy" and "hidden observation" can only occur with subject approval.

C. Confidentiality--subjects have the right to assume that all data associated with their actions will remain confidential and that coding and other techniques will be used to protect privacy.

D. Protection from physical and mental stress, harm, or danger--subjects have the right to assume that all treatments are free of danger. Subjects further have the right to assume that research staff (e.g., equipment operators, technicians, clinicians) have the professional training necessary to assure that participation in a research study will be safe and free from harm. Subjects additionally have the right to assume that the methodology has been selected to remove all reasonable and unreasonable risk.

E. Knowledge of outcomes--subjects have the right to know why the research study is being conducted and the results of the investigation. Notification of results can take many forms, ranging from a distributed summary of outcomes to publication of results in a professionally recognized journal.

TASK A.05

01. Review objective 02.

02. Consider the following scenario:

You have been "borrowed" by another division of your company. You have a temporary task of conducting a research study into company finances. You have been told that you will go back to your old job as soon as the research study is completed.

As a result of your involvement in the study, you discover that the supervisor in your "home" department is wasting thousands of dollars each month. There is even data to support the suspicion that the lost money is being used for personal gain.

03. Within this limited body of background information:

A. How would you write your report? Would you be truthful, or would you "edit" the report to diminish the observed problem involving wasted funds?

B. Would you speak with anyone before releasing the final report? If so, with whom?

C. What are some of the possible consequences of your report?

A well-composed one or two paragraph description should be sufficient for each question.

TASK A.06

01. Review objective 02.

02. Consider the following scenario:

You have been given the charge by your direct supervisor to conduct a research study at work. You have no reason to believe that participation in the study will be harmful in any way. You are concerned, however, that awareness of the study may affect results.

03. Within this limited body of background information:

A. Is it necessary to tell your subjects that they are being investigated?

B. How would you react if someone found out about the study and insisted that their awareness/approval was necessary?

A well-composed one or two paragraph description should be sufficient for each question.

TASK A.07

01. Review objective 02.

02. Consider the following scenario:

You served as a volunteer in a research study. As a professional courtesy, you have been provided with a summary report of the study. You review the report and discover that coding was not followed. Instead, your name (and the name of all other subjects) and associated data are clearly identified.

03. Within this limited body of background information:

A. How would you react when you discover the use of your name instead of a code?

B. In your profession, what would happen to the principal researcher if the names of subjects were easily determined (e.g., directly mentioned, poor coding)?

A well-composed one or two paragraph description should be sufficient for each question.

TASK A.08

01. Read information specific to your profession and place of work relating to ethics and standards of acceptable behavior.

02. Review objective 02.

03. Develop a code of ethics that would apply to research activities as well as your regular duties. The code of ethics should be far more comprehensive than merely restating the Golden Rule.

Instead, the code of ethics for this task should include:

A. Background statement on why the code of ethics is necessary

B. Mission

C. Goals

D. Objectives

E. Specific criteria associated with compliance

F. Consequences associated with violation of the code of ethics

Note. The purpose of this task is to ask you to prepare a draft code of ethics that would provide you with the proper guidance on standards of acceptable behavior for your MOE, practicum, and dissertation activity.

Problem Identification

Research is conducted so that questions about problems can be answered with some degree of confidence. Although it may seem too obvious to mention, it is important to recall that a problem must be identified before it can be resolved.

Technically-oriented professionals must use caution, however, in how they identify problems. This is certainly not the place to go into detail, but it is recognized that there is a wide continuum of problem identification, ranging from "putting out fires" to "professional leadership." A true professional recognizes the difference between involvement in easily solved problems as opposed to issues of a broader scope that truly demand the attention of someone who is experienced in research and in making critical observations and judgments.

Professional leadership is as much a part of a doctoral program as cognitive development. As such, it is expected that students in this course will focus on the investigation of problems that are professionally-oriented and that they will learn to think beyond basic "maintenance" of the status quo.

TASK A.09 01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 32-33

02. Review objective 03.

03. Provide a description of a problem at your place of work that is of importance to you as a professional in a computer-based environment. Give this problem careful thought since you may continue with this situation throughout the remaining tasks for Assignment A and possibly throughout other Nova CCIS/CBL experiences.

As an example:

Your company/school has been using Product X Version 6.8 software for spreadsheet analysis. The vendor, however, announced that Version 6.8 will be replaced with a totally new version, Version 7.0. After a two month phase-in period, Version 6.8 software will no longer be supported by the vendor.

Concurrently, another vendor is vigorously marketing their spreadsheet software, Product Z Version 3.7. The vendor claims that it is just as useful as Product X Version 6.8.

In this example there are many problems:

A. Do you stay with Product X Version 6.8 even though it will not be supported?

B. Should you "move up" to Product X Version 7.0 even though you are very satisfied with Product X Version 6.8?

C. Should you "switch" to a totally new form of spreadsheet software, Product Z Version 3.7?

D. If you remain with Product X Version 6.8, what will you do if you need support and support is not provided?

E. If you switch to Product X Version 7.0, will you have sufficient resources to train your staff on how to use the new software?

F. If you accept Product Z Version 3.7, what will you do if there is a compatibility problem with old Product X Version 6.8 files?

When you attempt this task, be sure to clearly identify the scenario. Be sure that the problem is of appropriate scope for someone in your professional position. Be sure to identify how the "obvious" problem leads to many "sub-problems" that are also vitally important. The above example should serve as a guide on how to construct this task.

Hypothesis/Objective Development

A general clarification may be necessary between the concept of research hypothesis and research objective. The difference between the two terms is often a matter of methodology:

1. A research hypothesis (and subsequent null hypothesis) is usually associated with the use of inferential research (i.e., a type of research design where the population is not known, causing the need to "infer" if data associated with the study actually reflect the general population). A typical research hypothesis would be: "There is a difference between group A and group B in terms of characteristic X."

2. A research objective (usually stated in measurable or behavioral terms) is merely a statement of intent, and is restricted in focus strictly to the individual study and data deriving from the study. A typical research objective would be: "At the completion of the project, subjects will be able to run one mile in four minutes.

TASK A.10

01. Read:

Isaac, St phen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 184-186

02. Review objective 04.

03. Using the same scenario/problems identified in TASK A.09, develop either a tenable research hypothesis or a research objective.

A. Sample research hypotheses that could be developed from TASK A.09:

(1) There is no difference in company benefit between Product X Version 6.8 and Product Z Version 3.7.

(2) In terms of operator utility, any difference between Product X Version 6.8 and Product X Version 7.0 is due only to chance. There is no difference between the two spreadsheet versions, in terms of operator utility.

B. Sample research objectives that could be developed from TASK A.09:

(1) At the completion of a three week training program, 92 percent of all Product X Version 6.8 operators will be able to use Product Z Version 3.7 with full utility. Full utility is defined as an 85 percent correct score (or higher) on a standardized test associated with Product Z Version 3.7.

(2) During Fiscal Year 1990, the cost of retaining Product X Version 6.8 will be 20 percent less than the cost of upgrading to Product X Version 7.0. The Management and Budget office

> will audit all expenses related to Product X Version 6.8. The Research office will provide projections on the cost of upgrading to Product X Version 7.0.

The above example should serve as a guide on how to construct this task.

Note. Give very careful attention to the reading assignment for this task. The success/acceptance of many research studies is often a direct consequence of how well the research hypothesis/objective was stated. The research hypothesis/objective is the "engine" that "drives" the study.

Literature Review

Literature review, much like literature itself, can take many forms. Indeed, the concept of how information can be stored and retrieved has undergone such tremendous change that professionals involved in a research project now have available sources of information that could only be dreamed about years ago. Nova University's Electronic Library (el) and Information Retrieval Service (IRS) are only two examples of expanding opportunities of how information can be obtained and reproduced in various forms.

Regardless of the technology used to retrieve the work of other professionals investigating similar problems, a few "constants" should be observed when attempting this vitally important step in the research process:

A. Clearly identify the problem. A literature search is no place to conduct a "fishing trip." Precise identification of the problem and associated terms can only enhance the quality of resource retrieval.

B. Because today's technology only too often gives us more information than we can reasonably utilize, learn to carefully examine abstracts, annotations, and other parts of the literature that save time while providing effective literature review.

C. Always remember the professional courtesy (and responsibility) of accurately citing the work of others. Be as precise as required so that an interested reader could easily use your citation to consult the original source.

Be certain that you are aware of Nova University's policy on original work. You will also need to follow standard practice regarding the citation and reproduction of other's work. It is expected the the issues of accountability and legal requirements regarding information citation/reproduction will only increase in importance as information retrieval and reproduction become more simplified.

TASK A.11

01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 221-222

02. Review objective 05.

03. Provide a brief (one paragraph) description about the value of literature review in a research study.

The "mechanics" of literature review as well as your opportunity to use Nova University's Electronic Library and Information Retrieval Service will be explained by subject-matter experts during this course.

Research Methodology

Accurate identification of methodology is often regarded as the most critical part of a research project. Methodology is also the part of a research report that is most easily challenged by those who wish to disagree with outcomes or conclusions (e.g., faulty methodology results in faulty conclusions).

Obviously, there are limitations on how detailed the methodology section of a research report should be. It may be helpful to think of the required components of a well-developed methodology section to resemble the essential elements of a well-composed newspaper article:

A. Who--everyone with the project must be identified. It is also important to identify how participants (e.g., researchers, subjects) were selected, especially if the concept of random selection applies to later data analysis.

B. What--every measurement must be provided. There are limitations, however, on the appropriate means of presenting data. Indeed, the concept of data reduction is a vital concept for researchers who expect to generate effective reports. (Many experienced researchers prefer to exercise data reduction by synthesizing the data into the form of a table. Pertinent tables are usually included in the front matter of a report. Additional data are often appended into the back matter.)

C. When--exact dates and times are essential for full identification of methodology. (It may also be helpful to cite local events if the timing of these events could possibly influence results. A timely example for this consideration could be "What Role Should the Federal Government Assume in Meeting the Basic Needs of the Homeless?" Government funding is often based on research results, ar ' many government studies employ analysis of public c inion. Imagine how attitudes toward the homeless could be quite different only because of timing: frozen bodies on city streets in January receive immediate attention in the media as opposed to an "invisible" problem of people drifting along our streets in July. In July public opinion toward the homeless would likely be much different than public opinion during January.)

D. Where--location of events affects outcomes and must therefore be identified. In education, training, and even in the hard sciences, results are often a factor of location. Many projects that were very successful in a laboratory were unsuccessful in a non-laboratory setting. "Where" may also have an influence on subject selection, especially in research associated with the social sciences.

E. Why--procedures must be justified and based upon sound principles of practice. Too often, the concept of justification of practice is neglected, even by experienced researchers. It is argued that it is just as important for a researcher to justify their actions as it is to report results in an unbiased manner. Quite simply, the rationale associated with selection of procedures has a major effect on outcomes--we often "find" what we want to find. Readers have a right to know the underlying influences and pejorative judgments associated with the study.

F. How--methodology and the general course of action should be so clear that a peer or other experienced colleague/associate should be able to either replicate the study or complete the study if the original researcher were unable to continue. Many researchers prefer a narrative description of events with a summary of activities in the form of a table or appended log. Of course, there is eventually a limitation of how much detail is required to clearly identify methodology. And, it is certainly recognized that methodology is not a "cookbook recipe" where steps are in a sequential order only. But, description of procedures is often an area requiring detail, among beginning students and experienced professionals alike. It is easy, but dangerous, to assume that our actions are so obvious that they do not require explanation.

Assumptions and Limitations

Each research study is based upon underlying assumptions and limitations. An operational definition may help clarify the difference between these two terms and why it is necessary to provide a full explanation of the concepts associated with these terms.

A. Assumption: accepted truths associated with the study. A very common assumption in survey research is that differences in opinion are interval data. That is to say, when responding to a statement by marking 1 (LOW), 2, 3, 4, or 5 (HIGH), it is assumed that the data are interval and that the difference between "1" and "2" is equal to the difference between "4" and "5."

B. Limitation: constraints on the design of the study and subsequently the ability to generalize beyond the studied sample. A typical limitation is sample size. Many research studies would benefit from a sample size of 1,000 or more subjects. Because of a wide variety of limitations (e.g., time, money, "political" influences, expertise), however, the researcher can only conduct the study with a sample size of 100. Should the study be delayed until an adequate sample size can be obtained (if indeed this can be done at all)? Or, should the study proceed, recognizing the limitation (constraint) of an inadequate sample size? These questions are often problems associated with the reality of conducting research and are only a small example of factors that must be considered when conducting or analyzing a research investigation.

Data Collection

Data can take many forms. The number of communicants in a parish is one datum. The religious conviction among these communicants is an entirely different type of datum. Yet, both types of data would be associated with a research study into the religious beliefs and practices of members of a particular area.

Data can also be conceptualized from many perspectives. One way to view data is to differentiate between parametric data and nonparametric data:

1. Parametric data are "measured" data (Best, 1981:220). In the previous example on responses to a survey statement, selection of a "2" or a "4" is a measured datum. (The researcher "measures" reaction to a particular statement through administration of the survey).

2. Nonparametric data "are either counted or ranked" (Best, 1981:221). Imagine a group of people and weights. The individual weight of one specific person would be a parametric datum (e.g., 152 pounds). However, the number of people in the group under 152 pounds would be a nonparametric datum. In this case, you are merely "counting" the number of people who fit a previously identified criterion.

The difference between parametric data and nonparametric data need not be confusing (although it often is). If the datum was "measured," then you are dealing with a parametric datum. If the datum was merely "counted," then you are involved with a nonparametric datum. (Selection of tests for statistical analysis and the ability to select the appropriate test are an important reason for learning how to differentiate between parametric data and nonparametric data.)

Another way to conceptualize data is to differentiate between how data can be quantified or measured. Best (1981:154) defined the quantification of data and the general concept of measurement as "a numerical method of describing observations or materials or characteristics." Siegel (1956:21), in the definitive text on nonparametric statistics, simply stated that "the relation between the things being observed and the numbers assigned to the observations is so direct that by manipulating the numbers the physical scientist obtains new information about the things."

Accordingly, it is generally agreed that there are four "types" or "levels" of data measurement:

1. Nominal measurement: level 1 measurement. Nominal data are "counted" and are conveniently placed into predefined categories.

A common example is to count the number of males and females in a sample. Assuming that each subject can only be either male or female at any one time, the number of male subjects is a nominal datum.

2. Ordinal measurement: level 2 measurement. Ordinal data are "ranked" data. As such, ordinal data allow greater inference than data associated with the nominal scale.

To return to the previous example on weights, imagine that the sample consisted of six subjects:

Tom ...... Subject A	Bob ..... Subject B
Sally .... Subject C	Ted ...... Subject D
Ruth ..... Subject E	Mona ..... Subject F

As an example of how ordinal data can have utility in understanding relationships between subjects, imagine that you do not have a bathroom scale, but you instead use the concept of water displacement to "measure" the weights of each subject. After this procedure you observe that the rank order (ordinal measurement) listing of subject weights, from heaviest subject to lightest subject, is:

(1) Ted

(2) Mona

(3) Tom

(4) Bob

(5) Sally

(6) Ruth

It is now possible to easily see that Ted is the heaviest person in the group and that Bob weighs less than Tom. (Notice, however, that the data do not support the assumption that Bob is "thinner" than Tom. The concept of "thin" or "overweight" is a matter of pejorative judgment based upon operational definitions that are not provided in this example. Instead, you can only observe that Tom weighs more than Bob.)

3. Interval measurement: level 3 measurement. Interval data are measured in "equal intervals." That is to say, "61," "32," and "93" could conceivably be three possible measures on an interval scale. Just by knowing that these measures are associated with an interval scale, you are able to make greater inference than the ability to generalize when using data associated with the nominal or ordinal scale. As an example, you can assume that with an interval scale, the difference between 61

and 62 is equal to the difference between 92 and 93. You may not know what the difference represents, but you can assume that the differences are equal.

The interval scale does have some limitations. Consider a situation where scores on a test (measured on an interval scale) ranged from 31 to 98. One point on this scale is 70. With interval data you may know that points on the scale represent equal units of measurement, but extreme caution is necessary for any further assumptions. You may be incorrect if you assume that a "70" is twice as much as "35."

Another limitation of the interval scale is that there is no "true" zero. Imagine the limitations of basic math if no zero existed. The interval scale is a very useful (and common) scale, but it is not the most rigorous scale for the measurement of data. (Most questionnaires and survey instruments are designed to take advantage of the interval scale. The most typical example of the interval scale involves use of Likert-type ratings. The common structure of Likert-type ratings is to construct a scale where 1 = LOW and 5 = HIGH. Then, ratings are analyzed by giving attention to: Number Responding, Mean, Standard Deviation.)

4. Ratio measurement: level 4 measurement. Ratio data have the characteristics of interval data, but ratio data also have two other very important characteristics:

A. Ratio data have a true zero (e.g., zero pounds indicates the "absence" of weight). (Be very careful to identify measuring units. In this example, zero pounds indicates the absence of "weight." But, zero pounds does not indicate the absence of "mass." Weight and mass are two different measuring units and you cannot assume that your reader will be able to accurately infer the measuring unit. Instead, it is your responsibility to provide that datum).

B. Ratio data are "real" numbers and they can be subjected to standard mathematical procedures (e.g., addition, subtraction, multiplication, division). Because of this characteristic, ratio data can be expressed in "ratio" form. With ratio data, you can assume that "50" is truly "twice the measure of 25."

From the previous example on subject weights, you may notice that you do not know exactly how much individual subjects weigh. Neither do you know exactly how much "more" Ted weighs than Mona or how much "less" Sally weighs than Ted. You also do not know if Bob's weight is two-thirds the weight of Mona. To obtain this information you would need measurement on a ratio scale such as the data typically produced by weighing subjects on a scale. If Ted weighed 167 pounds and if Mona weighed 165 pounds, then you would know that Ted is two pounds heavier than Mona. (It is assumed, of course, that the scale is consistently accurate when used. But, that is another issue associated with reliability and validity of data.)

Up to this point, it might appear that data were restricted only to numerical representation, whether the representation involved "counted" data (e.g., number of red-haired girls with freckles and pigtails in a Kindergarten class) or "measured" data (e.g., baud rate of a prototype modem). However, there are many other types of data and forms of data representation. And, data can be obtained from many sources and not only from "measurement" gained from a high-tech measuring device.

As such, an operational definition of data may help clarify the difference between "numerical" data and "non-numerical" data. Norusis (1988:2) defined data as "any materials that serve as a basis for drawing conclusions." Numbers are certainly a type of data, but numbers are not the only type of data. Other types of data would include:

A. Documents

B. Anecdotal records or observations

C. Physical objects

D. Affidavits and oral testimony

Because of the inherent limitations associated with many research projects, many researchers (including students in the Nova University Center for Computer and Information Sciences) would be well-advised to remember that valuable contributions have been made to many professions with non-numerical data. Again, it is cautioned that the numerical treatment of data is often a contrived procedure based upon the Eurocentric desire to quantify everything into measurable terms. As in nearly all ways of life, we tend to reflect our cultural background--even in the way we conduct research and evaluation.

TASK A.12 01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-

25-9 Pages 32-98, 101-110, 112-144, 149-150, 158-169, 222, 224-225

02. Review objectives 06, 07, and 08.

03. Develop a methodology section for a research study. You may wish to continue with the example from TASK A.09 and TASK A.10. Or you may wish to refer to another researchable problem.

Regardless of the selected problem, the methodology should be so well developed that you provide the equivalent of a "research blueprint" for someone else who would need to duplicate your work.

Among the many criteria included in a methodology section, it is customary to give attention to the following:

A. A brief review (i.e., overview) of the situation. This review serves as a reinforcer to maintain interest in the study. The review also serves as a courtesy for those who do not have the luxury of reading prior materials in depth.

B. A general description of the research methodology used in the study.

(1) Research hypothesis, often stated as a null hypothesis

(2) Research objectives

(3) Actual research methodology (e.g., historical, descriptive, developmental, case or field, correlational, causal-comparative, true experimental, quasi-experimental, action)

C. A clear identification of population and sample/sampling methodology.

D. Description of any measuring instruments. As a courtesy, it is common to provide a general description of how measurements were made, with the actual instrument appended in the back matter (if papercopy instruments are used; mechanical instruments are instead identified by the most appropriate means available, often by reference to catalog code numbers or by the use of photographs or figures).

E. The setting should be accurately described. Depending on the rigor of the study, you may need to provide a very detailed description of the location and all conditions associated with the study.

F. Data collection processes and procedures.

Within the wide degree of freedom allowed for individual writing and reporting styles, it is generally accepted that the following criteria will be addressed in this section:

(1) How were the data obtained (e.g., electronic printout from a computerized diagnostic device; responses to an opinion survey; an audit of company records)?

(2) What was the measuring scale (e.g., nominal, ordinal, interval, ratio)?

(3) What was the process for data organization, especially if the data were non-numeric?

(4) Was there an estimation of the reliability and validity of data collection processes (e.g., are the data reliable, are the data valid)?

G. General indication of how data will be analyzed. A complete description of data analysis is often provided in the results section.

H. A definition of terms for any terms that are unique to the study or for any terms that have an idiosyncratic meaning. (Terms are usually provided in alphabetical order unless there is specific reason for an alternate hierarchy).

I. Assumptions and limitations are also often placed in the methodology section.

There can be no standardization for this assignment. Each methodology is unique and rigor, length, and format will also be unique. Even so, it is suggested that this task should be no more than five to seven pages. Of course, the methodology section of a practicum or dissertation will be much longer, but this task is merely an exercise in how to develop a methodology section. You are advised to be in communication with your instructor before you attempt this task since this is a major task. And, recall that there is no universally accepted means of documenting research methodology. Research would be very dull if a template was used for all activities.

Data Analysis

Data analysis could also easily be referred to as "data organization." The researcher who is able to organize data into an easily understandable presentation is the researcher who will gain greater attention from peers and the general community of those concerned with the results deriving from the research study.

Two terms often associated with data and data analysis are: descriptive analysis, and; inferential analysis. Complete differentiation between these two terms can be found in the many comprehensive texts associated with data analysis. Even so, a brief differentiation between the two terms would identify where:

1. Descriptive analysis is limited in scope to the subjects observed or measured. If a run of 450 CD-ROM disks were observed for flaws, then any descriptive statistics deriving from the analysis of these disks would be restricted in focus to the 450 disks examined and only the 450 disks examined. An example of descriptive analysis is: "Based upon analysis of 450 CD-ROM disks, it was observed that 99.33 percent (447/450) of all disks were free of flaws."

2. Inferential analysis is a type of data analysis that attempts to make generalizations beyond the observed subjects. With reference once again directed to the CD-ROM disks, descriptive analysis would be restricted in focus to only the observed disks. Inferential analysis, however, would report on the observed disks, but inferences (e.g., judgment, conclusions) about the entire production run (perhaps 10,289 disks) would be made based on the observations associated with analysis of the 450 disks.

An example of inferential analysis is: "It was observed that there were significant differences in production quality of CD-ROM disks produced by day shift workers and night shift workers in a typical factory setting. Disks produced by night shift workers had significantly more flaws than similar disks produced by day shift workers. As such, it is recommended that further investigations should be conducted to determine if the quality of disks produced by night shift workers is at a point where special efforts should be taken to remediate this problem." (In this example, the word "significance" is a term with statistical overtones that has not been previously addressed. The issue of statistical significance and practical significance is also addressed in this example. These issues will be given greater attention during instruction.)

Notice how the two examples about the quality of CD-ROM disks are free of pejorative judgment. It is never suggested that production is "good" or "bad." Instead, analysis of the data was conducted so that observations could be stated in a straight-forward manner. There is a time and place for judgment, but data analysis is not the place for editorial comments and statements of judgment.

Many techniques for data analysis have evolved from this differentiation between descriptive analysis and inferential analysis. These techniques for data analysis could take many forms. The following is only one representation of the difference between descriptive analysis and inferential analysis:

1. Descriptive analysis, as the term implies, refers to presenting data only in descriptive terms. Detail is provided in associated texts (Best, 1981; Norusis, 1988), but techniques typically associated with descriptive analysis include:

A. Methods of data organization

(1) Array

(2) Frequency table

(3) Histogram and similar tools for the visualization of data

B. Measures of central tendency

(1) Mode

(2) Median

(3) Mean

C. Measures of dispersion

(1) Range

(2) Variance

(3) Standard Deviation

D. Measures of relative position or amount

(1) Percentage

(2) Percentile

(A) Percentile rank

(B) Percentile score

(3) Standard Score

E. Measures of relationships

(1) Scatter diagram

(2) Coefficient of correlation

(A) Pearson's Product-Moment

(B) Spearman's Rank-Order

2. Inferential analysis, as previously suggested, is used to make "inferences" or judgment. Inferential analysis goes beyond the mere reporting (e.g., description) of data. Instead, a small group of subjects (i.e., sample) are studied, and conclusions are drawn to make judgment about the larger group (i.e., population) the small group ostensibly represents. (The word "ostensibly" was purposely used in this example. Sample

selection as a representation of overall population is a notion so ingrained to the efficacy of research that the concept of sample selection must always be a consideration of the entire research process.) The tests for data analysis that many people associate with statistics and empirical research in general are examples of inferential analysis. Reference is once again directed to resource texts (Best, 1981; Isaac and Michael, 1981; Norusis, 1988; Siegel, 1956) for a complete understanding of the appropriate uses of each statistical technique, but a brief listing of inferential analysis would include:

A. t-test (Student's Distribution)

B. Chi-Square

C. Analysis of Variance (ANOVA)

D. Multivariate Analysis

   (1) Multiple Linear Regression

   (2) Discriminant Analysis

   (3) Factor Analysis

It is once again cautioned, however, that data analysis is not restricted in focus to merely using mathematical computations and other forms of statistical analysis. Quite the opposite, many well-accepted research reports have used only a cursory attempt to include "numerical" data analysis. Kerlinger (1973) is an excellent source for those who need to conduct research where the design simply does not support the need (or ability) to obtain numerical data. Interviews, observation of behavior, and content analysis of narrative comments are only three means of conducting research that is not numerical in initial intent. Remember--there is no "magic" to the use of numbers in research. Numbers (and subsequent use of these numbers for mathematical computation and statistical analysis) are only a convenient tool for representing data.

TASK A.13

01. Read:

    Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 158-183

02. Review objective 09.

03. Based upon the data and situation identified in TASK A.12, indicate how you would analyze the data.

    Please note: you are not asked to perform any statistical analysis for this task. You are only asked to describe how you would analyze the data--regardless of whether descriptive and/or statistical analysis would be used. Your instructor will concentrate on the appropriateness of the data analysis process--not on your ability to conduct inferential statistical analysis. It is suggested that you consult with your instructor before attempting this task. Again, there can be no standardization for this task. (Statistical analyses are covered in other assignments).

    A. For many studies, a basic spread-sheet program such as Lotus 1-2-3 and its @ function commands may be more than satisfactory to perform the task of data organization and analysis.

    B. For other studies, robust techniques such as discriminant analysis may be required. An advanced process such as Minitab, S, or SPSS may be required.

C. Of course, there will be cases where no numerical data analysis is used since it was perceived that the problem and scope of the problem did not support numerical data analysis.

Remember--your readership will largely determine the data analysis process. If you know that your readership cannot and will not accept sophisticated statistical analysis, then use a data analysis technique that your readership will accept. Attempt to change the behavior toward acceptance of data analysis if you will, but remember that behavior is only slowly changed in most cases.

Again, there is no standardization for this task. The task of how you present and analyze data is very demanding at the practicum and dissertation stage. This task is only a brief model (three to five pages) of what you will attempt in later work.

Presentation of Results

Objectivity, deliberate actions, and the desire to explain the unknown are the keys to successful research. Of these three criteria for successful research, objectivity is quite likely the driving force to producing quality work. Otherwise, we are likely (without direct awareness) to allow our biases and feelings to influence research measurements and, ultimately, the outcomes of a research project.

Of course, unbiased presentation of results is only a continuation of unbiased design, sample selection, measurement, and all of the many other factors where personal bias could influence outcomes. As such, a review of Isaac and Michael's (1981:85-87) excellent discussion on sources of error in research is perhaps necessary:

A. Error--the disquieting phenomenon of collecting data in a precise and orderly manner, but still having error occur because of incorrect design. Great care and thought must be given to methodology and design. In general, a faulty research design invalidates all other aspects of a research project.

B. Halo/Horns Effect--the fair-haired child who can do no wrong; the new piece of equipment that will solve all problems; personal bias for or against someone or something are all possible examples of the Halo/Horns Effect.

C. Hawthorne Effect--the tendency for people to do their best (or worse) when they know that they are participating in a research investigation.

D. John Henry Effect--the tendency of a control group to outperform the experimental group once group status is known.

E. Law of the Instrument--the tendency to use a favored technique or statistical test only because of preference, personal bias, or familiarity.

F. Placebo Effect--the use of an otherwise meaningless device or treatment to ensure that control and experimental groups receive equal treatment.

G. Post Hoc Error--the fallacy of incorrectly concluding that a cause-and-effect relationship exists. Please recall, correlation does not suggest cause and effect.

H. Rating Errors--the tendency of raters to make judgment in a consistent manner (always low, always high, always toward the middle) bring to attention how rating errors can influence measurement.

I. Self-Fulfilling Prophecy--the tendency to "discover" what was originally desired.

J. "Typical" Case Studies--the use of ideal rather than typical subjects or case studies. Randomization in the selection process must be followed if results are to be generalized to the entire population.

Research Summary

Research reports must be objective--a research report is quite different from a position paper. However, research reports that only "report" findings are lacking in depth and potential to produce professional impact. Unbiased presentation of results is a major responsibility for any researcher, but the ability to synthesize research results into a document that brings about change is the true purpose of research. Research is conducted to produce positive change--collection of data and presentation of results are only steps in the process of effecting professional change.

Discussion of research findings, like all other parts of a research report, is most effective if an organized format is followed. Although there is certainly opportunity for stylistic preference and individual writing styles, effective summaries have common elements:

1. The researcher may want to begin the summary section with a brief reiteration of the problem statement and general methodology. The use of this practice is especially helpful with research reports that are either long or highly technical. The value of periodic reinforcement applies to writing as well as to other phenomena.

2. The researcher may also want to briefly recap the major results associated with the study. It is not necessary to go

into excessive detail, but research reports are most effective when the reader has a full understanding of facts and findings.

3. After major findings are presented, it is then appropriate to go into greater detail and discuss the many subtle relationships associated with the data. As an example, a researcher may have previously demonstrated that there was a significant relationship between X and Y. It is in the discussion/summary section where the implications of this relationship should be explored. It may be that the relationship is an interesting phenomenon, but it may also be that no practical value can be ascribed to the relationship. However the results of a research study are used, it is in the discussion/summary section where the researcher goes into depth and explores the nature of the findings. Quite simply, the discussion/summary section is the section where the data and associated findings are interpreted and evaluative statements evolving from data interpretation are considered appropriate.

4. It is also the responsibility of the researcher to offer recommendations for the improvement of practice. As with all aspects of a research report, recommendations should be based upon analysis of the data (e.g., findings) and should also be logically derived from the interpretation of the data.

It is often confusing for students and beginning researchers to list recommendations. The process is actually quite simple if the concept of hierarchy is used:

A. If there is a hierarchy or sequential order to the recommendations, then recommendations should be presented in sequential order. It may be that recommendation #6 is moot if recommendation #5 is not first considered and placed into effect. Accordingly, the concept(s) associated with recommendation #5 demand attention before the concept(s) associated with recommendation #6 are mentioned.

B. If there is no sequential order to the recommendations evolving from the study, then most researchers prefer to present the recommendations in an order similar to the presentation of results. It may be possible to develop a table where results are listed in the left column and recommendations are presented in the right column. Of course, this may not always be possible, but anything that a researcher can do to make data more comprehensible is likely to increase the potential effect of the report.

TASK A.14

01. Read:

Isaac, Stephen, and William B. Michael. HANDBOOK IN RESEARCH AND EVALUATION. 2nd edition. San Diego, California: EdITS Publishers, 1981. ISBN 0-912736-25-9 Pages 220-225

02. Review objective 10 and objective 11.

03. Continue with the work that you have started in previous tasks. Although some of your work may have been, to a degree, hypothetical, it would be desirable for later use if the problem, data, and data analysis were based upon work that you could eventually use.

Even if your work is somewhat hypothetical, use the previously addressed tasks to develop a summary that serves as both a summation and as an argument to defend a position.

The summary (often referred to as Discussion, Implications, and Recommendations) should follow the proposed format:

A. Discussion:

(1) A brief review of the study

(2) A brief reference to the work of others who are investigating similar problems (e.g., the literature review)

(3) A brief review of findings associated with the study

B. Implications:

(1) Immediate concerns (e.g., now that the study is completed, how would you answer "So what?")

(2) Secondary issues that could develop into major concerns

(3) Further discussion of how the study can be used to resolve concerns or answer questions

C. Recommendations:

(1) Realistic

(2) Hierarchy of importance

(3) Suggestion for improvement to the profession

Think of the summary section as being similar to what you may have learned in speech class when you practiced argumentation. Your responsibility is to influence actions by changing behavior. Start with what your readership will already accept and then continue to provide interesting narrative description and other means of presenting data as a means of bringing your readership into agreement with your position.

COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT B

Electronic Cluster

January 01 to June 30, 1990

Thomas W. MacFarland, Ed.D.

Nova University

Center for Computer and Information Sciences

Fort Lauderdale, Florida 33314

COMPUTER BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT B

General Instructions

Greetings and welcome to Assignment B for IS 7100. I sincerely hope that you enjoyed Assignment A and that you can now appreciate the need for a core course in research and statistics.

1. Review the entire assignment before you answer any questions.

2. Using the most appropriate means, answer the questions in the form of a file that will be later submitted through esXXX.

3. Give complete answers and document all calculations (i.e., show your work), if necessary.

4. Follow standard practice in use of the English language. It is best to use a "spell check" to be assured of spelling.

5. Review your answers to see that the questions were accurately answered.

6. Submit the assignment through esXXX.

How to Answer Questions

There is no "hidden agenda" to this assignment. Instead, questions and/or concomitant scenarios have been worded clearly. In turn, I expect accurate and clearly worded answers. Answers are discrete (i.e., either right or wrong) and they will be graded accordingly.

Many questions are based on attached SPSS/PC+ Studentware files. Please let me offer two comments about these files:

1. You may use Minitab, Mystat, S, SAS, SPSS (Studentware, PC+, X), or any other software for conducting analyses in Assignment B. Or, you may instead prefer to conduct all analyses for this assignment "by hand." The selection of software (if you use software for Assignment B) is a personal concern. I only request that:

A. Documentation is needed to demonstrate "how" calculations were conducted. You may find it best to upload a file or you may instead choose to construct a script file. Either practice is quite acceptable.

B. Do not return the attached SPSS/PC+ Studentware files. I have copies of these files and it is not necessary to exceed your quota by resubmitting these files.

C. Instead, the file for Assignment B should consist of:

(1) A restatement of the question/scenario, and

(2) Your answer.

2. For this assignment, I am far more concerned with your ability to organize and interpret data and research/ statistics than your ability to program statistical software. Leadership, not programming per se, is an intrinsic goal of your doctoral program.

Index

Q01 ..... Descriptive Statistics

Q02 ..... Student's t-test With Two Independent Samples

Q03 ..... Student's t-test With a Paired Sample

Q04 ..... Chi-Square

Q05 ..... Pearson's Coefficient of Correlation

Q06 ..... Oneway ANOVA

Q07 ..... Syntax

Q08 ..... Syntax

Q09 ..... Types of Research

Q10 ..... Research Designs

Q11 ..... Sampling

Q12 ..... Test Development

Q13 ..... Levels of Quantitative Description

Statistical Analyses: Calculation and Interpretation

Q01: Descriptive Statistics

Please review the attached file, mean-sd.log. Use the information provided in mean-sd.log to complete Table Mean-SD.

Table Mean-SD

Sample #1	Sample #2	Sample #3
Median = 40.00	Median = xx.xx	Median = xx.xx
Mean = xx.xx	Mean = 33.67	Mean = xx.xx
SD = xx.xx	SD = xx.xx	SD = 36.16

Note. Standard practice was used for rounding.

```
***********
mean-sd.log
***********

[Next command's output on page   1
include 'mean-sd.dat'.
[SET WIDTH = 75.
[
[*  Test:        Descriptive Statistics
[*
[*  Software:    SPSS/PC+ Studentware
[*
[*  Scenario:    Based on data provided in Table 1, determine the
[*               following for each sample:
[*
[*               1.  Median
[*
[*               2.  Mean
[*
[*               3.  Standard Deviation
[*
[*
[*                                    Table 1
[*
[*                                 Summary Data
```

```
[*
[*
[*
[*
[*        Sample #1           Sample #2              Sample#3
[*
[*
[*         0039                 0100                   0100
[*         0042                 0004                   0004
[*         0040                 0007                   0007
[*         0037                 0096                   0030
[*         0041                 0080                   0080
[*                              0003                   0030
[*                              0001                   0042
[*                              0010                   0002
[*                              0002
[*
[*
[*  Note:     Use the MISSING VALUE command so that all samples
[*            can be retained in the same file.
[
[DATA LIST /
[     Sample_1 01-04
[     Sample_2 06-09
[     Sample_3 11-14
[
[VARIABLE LABELS
[     Sample_1 "Sample #1"
[     Sample_2 "Sample #2"
[     Sample_3 "Sample #3".
[
[MISSING VALUE Sample_1 (0999) Sample_2 (0999) Sample_3 (0999).
[
[BEGIN DATA.
[0039 0100 0100
[0042 0004 0004
[0040 0007 0007
[0037 0096 0030
[0041 0080 0080
[0999 0003 0030
[0999 0001 0042
[0999 0010 0002
[0999 0002 0999
[END DATA.
FREQUENCIES VARIABLES = Sample_1 Sample_2 Sample_3 / Statistics
All.
[Next command's output on page   6
finish
```

Q02: Student's t-test With Two Independent Samples

Please review the attached file, t_inep.lis. Use the information provided in t_inep.lis to answer the following question:

Are the differences between Group #1 and Group #2 true differences? Or, are the differences instead due only to chance?

Computed t = 3.89

Criterion t = 1.697 (alpha = .05, df = 30)

Computed t (3.89) > Criterion t (1.697)

```
***********
t_inep.lis
***********

                              SPSS/PC+ Studentware      11/21/89
include 't_inep.dat'.
SET WIDTH = 75.

*  Test:       Student's t-test with two independent samples
*
*  Software:   SPSS/PC+ Studentware
*
*  Scenario:   Based on data provided in Table 1, determine if
*              there are true differences (alpha = .05) between
*              Group #1 and Group #2.
*
*
*                              Table 1
*
*                           Summary Data
*
*
*
*
*                 Group #1                      Group #2
*
*
*              36   35   39   46          26   27   37   29
*              31   36   29   31          38   36   29   36
*              43   38   33   32          33   24   22   28
*              42   47   47   36          25   31   31   30
*
*
*  Note:       In addition, calculate descriptive statistics for
*              each group.
```

```
*
*  Ho:         There is no difference between Group #1 and Group
*              #2 (alpha = .05).

DATA LIST /
     Group     01
     Score  03-04.

VARIABLE LABELS
     Group      "Group:  Group 1 or Group 2"
     Score      "Measured Datum".

VALUE LABELS
     Group      1 'Group #1'
                2 'Group #2'.

BEGIN DATA.
END DATA.
     32 cases are written to the compressed active file.

This procedure was completed at 19:31:59
T-TEST GROUPS = Group (1,2) / VARIABLES = Score.
-----------------------------------------------------------------

Page   2                    SPSS/PC+ Studentware
     11/21/89

Independent samples of  GROUP     Group:  Group 1 or Group 2


Group 1:  GROUP  EQ 1          Group 2:  GROUP  EQ 2


t-test for:  SCORE     Measured Datum

                          Number                  Standard     Standard
                         of Cases      Mean      Deviation      Error

            Group 1         16       37.5625       5.921        1.480
            Group 2         16       30.1250       4.843        1.211

                  Pooled Variance Estimate  Separate Variance Estimate

F      2-Tail    t    Degrees of 2-Tail     t    Degrees of  2-Tail
Value   Prob.  Value   Freedom    Prob.   Value  Freedom      Prob.

1.50    .445   3.89     30        .001    3.89    28.86       .001

This procedure was completed at 19:33:09
-----------------------------------------------------------------
```

Q03: Student's t-test With a Paired Sample

Please review the attached file, t_pair.lis. Use the information provided in t_pair.lis to answer the following question:

Are the differences between Method #1 and Method #2 true differences? Or, are the differences instead due only to chance?

Computed t = 3.85

Criterion t = 1.796 (alpha = .05, df = 11)

Computed t (3.85) > Criterion t (1.796)

```
**********
t_pair.lis
**********

                                SPSS/PC+ Studentware        11/21/89
include 't_pair.dat'.
SET WIDTH = 75.

*  Test:        Student's t-test with a paired sample
*
*  Software:    SPSS/PC+ Studentware
*
*  Scenario:    Based on data provided in Table 1, determine if
*               there are true differences (alpha = .05) between
*               Method #1 and Method #2.
*
*
*                               Table 1
*
*                             Summary Data
*
*
*
*               Pair             Method #1            Method #2
*
*
*               01               27                   21
*
*               02               22                   20
*
```

```
*            03            18            16
*
*            04            26            19
*
*            05            19            16
*
*            06            18            16
*
*            07            24            18
*
*            08            16            12
*
*            09            14            10
*
*            10            13            16
*
*            11            13            12
*
*            12            12            10
*         ____________________________________________
*
*  Note:      In addition, calculate descriptive statistics for
*             each method.
*
*  Ho:        There is no difference between Method #1 and
*             Method #2 (alpha = .05).

DATA LIST /
     Pair     01-02
     Method_1 04-05
     Method_2 07-08.

VARIABLE LABELS
     Pair     "Matched Pair: S1 to M_#1; S2 to M_#2"
     Method_1 "Score for Subject Assigned to Method #1"
     Method_2 "Score for Subject Assigned to Method #2".

BEGIN DATA.
END DATA.
     12 cases are written to the compressed active file.

This procedure was completed at 19:54:32

T-TEST PAIRS = Method_1,Method_2.
-----------------------------------------------------------------

Page    2                 SPSS/PC+ Studentware            11/21/89

Paired samples t-test:  METHOD_1  Score for Subject Assigned to
                                  Method #1
                        METHOD_2  Score for Subject Assigned to
                                  Method #2
```

Variable	Number of Cases	Mean	Standard Deviation	Standard Error
METHOD_1	12	18.5000	5.231	1.510
METHOD_2	12	15.5000	3.754	1.084

(Difference) Mean	Standard Deviation	Standard Error	Corr.	2-Tail Prob.	t Value	Degrees of Freedom	2-Tail Prob.
3.0000	2.697	.778	.870	.000	3.85	11	.003

This procedure was completed at 19:59:27
finish

Q04: Chi-Square

Please review the attached file, chi-fq.log. Use the information provided in chi-fq.log to determine computed chi-square. In addition, determine if the differences are true differences (alpha = .05), or are differences due only to chance.

Are the differences between degree of commitment to victim and response to a staged crime true? Or, are the differences instead due only to chance?

Computed chi-square = x.xx

Criterion chi-square = 3.84 (alpha = .05, df = 1)

```
**********
chi-fq.log
**********

[Next command's output on page   1
include 'chi-fq.dat'.
[
[SET WIDTH = 75.
[
[*  Test:        Chi-square (using all data)
[*
[*  Software:    SPSS/PC+ Studentware
[*
[*  Scenario:    Based on data provided in Table 1, determine if
[*               there are true differences (alpha = .05) between
[*               type of response and type of commitment to a
[*               staged crime.
[*
[*
```

Table 1

Summary Data

		Commitment	
		Committed	Not Committed
Response	Intervened	26	6
	Did Not Intervene	13	34

Note. For this analysis the following codes are used:

Intervened and Committed 1 1

Intervened and Not Committed 1 2

Did Not Intervene and Committed 2 1

Did Not Intervene and Not Committed ... 2 2

Ho: There is no difference between degree of commitment to victim and response to a staged crime (alpha = .05).

```
[DATA LIST /
[    Response  1
[    Commit_t  3.
[
[VARIABLE LABELS
[     Response "Response by Bystander to a Staged Crime"
[     Commit_t "Extent of Commitment to the Victim".
[
[VALUE LABELS
[     Response 1 'Intervened'
[              2 'Did Not Intervene' /
[     Commit_t 1 'Committed'
[              2 'Not Committed'.
[
[BEGIN DATA.
[1 1
```

```
[1 1
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[END DATA.
CROSSTABS TABLES = Response by Commit_t / Options 14 15 /
Statistics 1.
[Next command's output on page   4
finish
```

Q05: Pearson's Coefficient of Correlation

Please review the attached file, pearson.lis. Use the information provided in this file to determine if the coefficient of correlation is significant (alpha = .05).

Computed coefficient of correlation = .xxx

Criterion coefficient of correlation = .458
(alpha = .05, n = 14)

```
***********
pearson.lis
***********

                              SPSS/PC+ Studentware          11/22/89
include 'pearson.dat'.
```

```
SET WIDTH = 75.

*   Test:        Pearson's product-moment coefficient of
*                correlation
*
*   Software:    SPSS/PC+ Studentware
*
*   Scenario:    Based on data provided in Table 1, determine if
*                there is a correlation (alpha = .05) between number
*                of games won (baseball) and team batting average.
*                (American League teams from the 1986 season will
*                serve as the example for this exercise).
```

Table 1

Summary Data

Team	Number of Games Won	Team Batting Average
Cleveland	84	.284
New York	90	.271
Boston	95	.271
Toronto	86	.269
Texas	87	.267
Detroit	87	.263
Minnesota	71	.261
Baltimore	73	.258
California	92	.255
Milwaukee	77	.255
Seattle	67	.253
Kansas City	76	.252
Oakland	76	.252
Chicago	72	.247

```
*                ________________________________________________________
*
*  Ho:         There is no association between number of games won
*              and team batting average (alpha = .05).
*
*  Note.       Use (a) to signify an alphabetical string when key-
*              ing baseball teams.

DATA LIST /
     Team      01-20 (a)
     G_Won     22-23
     TBA       25-28.

VARIABLE LABELS
     Team      "American League, 1986 Season"
     G_Won     "Number of Games Won"
     TBA       "Team Batting Average".

BEGIN DATA.
END DATA.
     14 cases are written to the compressed active file.

This procedure was completed at 20:57:28
CORRELATION G_Won with TBA / Options 3 5 / Statistics 1 2.
------------------------------------------------------------------

Page    2                  SPSS/PC+ Studentware          11/22/89

Variable      Cases          Mean           Std Dev

G_WON            14       80.9286            8.8184
TBA              14         .2613             .0101
------------------------------------------------------------------

Page    3                  SPSS/PC+ Studentware          11/22/89

Variables                Cases    Cross-Prod Dev    Variance-Covar


G_WON    TBA               14             .6973             .0536
------------------------------------------------------------------

Page    4                  SPSS/PC+ Studentware          11/22/89

Correlations:  TBA

  G_WON          .6003
                (   14)
                P= .023


(Coefficient / (Cases) / 2-tailed Significance)
```

" . " is printed if a coefficient cannot be computed

This procedure was completed at 20:59:20
finish

Q06: Oneway ANOVA

Please review the attached file, anova1.lis. This file has been edited to avoid presentation of information not related to this question.

Use the information provided in this file to determine if the difference between Nematocide #3 and Nematocide #1 is true (alpha = .05). Or, is the difference due only to chance?

Be sure to provide evidence to defend your answer.

```
**********
anova1.lis
**********
                          SPSS/PC+ Studentware     11/22/89
include 'anova1.dat'.
SET WIDTH = 75.

*  Test:        Oneway Analysis of Variance (ANOVA), with
*               mean comparison (Tukey)
*
*  Software:    SPSS/PC+ Studentware
*
*  Scenario:    Based on data provided in Table 1, determine if
*               there are true differences (alpha = .05) between
*               Nematocides #1, #2, #3, and #4.
*
*
*                             Table 1
*
*                  Yield (Pounds per Plot for the Same Variety of
*                       Tomatoes) by Nematocide Treatment
*
*
*
*                             Nematocide
*
*
*                  1          2           3           4
*
```

```
*
*                  18.6      18.7       19.4      19.0
*
*                  18.2      19.3       19.9      18.5
*
*                  17.6      18.9       19.7      18.6
*
*                                       19.1
*
*                  ________________________________________________
*  Note:           In addition, calculate descriptive statistics for
*                  each group.
*
*  Ho:             There is no difference in yield between nematocide
*                  treatments #1, #2, #3, and #4 (alpha = .05).

DATA LIST /
    Group          01
    Yield          03-06.

VARIABLE LABELS
    Group          "One of Four Nematocides (a Pesticide)"
    Yield          "Yield of the Same Tomato Variety (Pounds/Plot)".

VALUE LABELS
    Group          1 'Nematocide #1'
                   2 'Nematocide #2'
                   3 'Nematocide #3'
                   4 'Nematocide #4'.

BEGIN DATA.
END DATA.
     13 cases are written to the compressed active file.

This procedure was completed at 22:13:51
ONEWAY Yield by Group (1,4) / RANGES = TUKEY / STATISTICS = ALL.


Page    4                    SPSS/PC+ Studentware
     11/22/89

             - - - - - - - - - - O N E W A Y - - - - - - - - - -


Group          Minimum       Maximum

Grp 1          17.6000       18.6000
Grp 2          18.7000       19.3000
Grp 3          19.1000       19.9000
Grp 4          18.5000       19.0000
```

```
Total         17.6000     19.9000


Page    5                      SPSS/PC+ Studentware
     11/22/89

                 - - - - - - - - - - - O N E W A Y - - - - - - - - - - -

      Variable  YIELD       Yield of the Same Tomato Variety
   By Variable  GROUP       One of Four Nematocides (a Pesticide)


Multiple Range Test


Tukey-HSD Procedure
Ranges for the  .050 level -

          4.41   4.41   4.41

The ranges above are table ranges.
The value actually compared with Mean(J)-Mean(I) is..
         .2583 * Range * Sqrt(1/N(I) + 1/N(J))


(*) Denotes pairs of groups significantly different at the  .050
level

----------------------------------------------------------------
Page    6                      SPSS/PC+ Studentware
     11/22/89

                 - - - - - - - - - - - O N E W A Y - - - - - - - - - - -

      Variable  YIELD       Yield of the Same Tomato Variety
      (Continued)


                             G G G G
                             r r r r
                             p p p p

     Mean        Group       1 4 2 3

    18.1333     Grp 1
    18.7000     Grp 4
    18.9667     Grp 2
```

19.5250 Grp 3 *

This procedure was completed at 22:17:57
finish

Topical Issues

Syntax

Q07

Please differentiate between the terms "research" and "evaluation." In the interest of brevity, please limit your answer to at most one paragraph for each term.

Q08

Why are statistical analyses nearly always based on the Null Hypothesis (Ho), the hypothesis of no difference?

Types of Research

Q09

Please offer a realistic scenario of a problem within your world of work that could possibly benefit from analysis through the process of a quasi-experimental approach. Be sure to keep your answer sufficiently brief, yet detailed to the point where major points and issues are identified. And, avoid the too often action of confusing "problem" with "solution."

Note: you are not asked to offer the equivalent of a Chapter 3. Instead, offer only a sketch of a real-world problem and evidence of how quasi-experimental research could be effected.

Research Designs

Q10

Using a research paradigm different than the paradigm identified in Q09, offer a synopsis of how a real-world problem related to your profession could be approached from a factorial design approach. A SPSS/PC+ Studentware file, anova2.log, is attached to offer an example of how the paradigm could eventually be presented.

Note: you are not expected to present your answer in the form of a data list file. You are not even expected to offer the statistical test associated with data analysis. Your only task for this question is to demonstrate an understanding of the complexity of factorial design by using an example related to your sphere of acquaintance.

```
**********
anova2.log
**********

[Next command's output on page   1
include 'anova2.dat'.
[SET WIDTH = 75.
[
[*  Test:       Twoway Analysis of Variance (ANOVA)
[*
[*  Source:     McClave, James T., and Frank H. Dietrich, II.
[*                   STATISTICS, 4th edition.  San Francisco,
[*                   California:  Dellen Publishing Company, 1988.
[*                   ISBN 0-02-379260-4  Page 544
[*
[*  Software:   SPSS/PC+ Studentware
[*
[*  Scenario:   Based on data provided in Table 1, determine if
[*              there are true differences (alpha = .05) between
[*              type of display, pricing, and interaction(s) of
[*              display and pricing.
[*
[*
[*                                  Table 1
[*
[*                Summary Data on In-store Promotions:  Unit
[*                   Sales by Display and Pricing Strategy
```

Display	Pricing Strategy: Regular	Reduced	Sell at Cost
	989	1,211	1,577
Normal	1,025	1,215	1,559
	1,030	1,182	1,598
	1,191	1,860	2,492
Normal Plus	1,233	1,910	2,527
	1,221	1,926	2,511

```
[*
[*                                1,226       1,516        1,801
[*          Twice Normal          1,202       1,501        1,833
[*                                1,180       1,498        1,852
[*
[*          ______________________________________________________
[*  Note:       In addition, calculate descriptive statistics for
[*              each group.
[*
[*  Ho:         There is no difference in unit sales between
[*              variations of in-store promotional displays and
[*              pricing strategies (alpha = .05).
[
[DATA LIST /
[     Treat_mt 01-02
[     Display     04
[     Price       06
[     Sales    08-11.
[
[VARIABLE LABELS
[     Treat_mt "Treatment # (3 Treatments/Cell x 9 Cells)"
[     Display  "Type of In-store Promotional Display"
[     Price    "Pricing Strategy"
[     Sales    "Unit Sales ($) for the Promoted Item".
[
[VALUE LABELS
[     Display  1 'Normal'   2 'Normal Plus'   3 'Twice Normal' /
[     Price    1 'Regular'  2 'Reduced'       3 'Sell at Cost'.
[
[BEGIN DATA.
[01 1 1 0989
[02 1 1 1025
[03 1 1 1030
[04 1 2 1211
[05 1 2 1215
[06 1 2 1182
[07 1 3 1577
[08 1 3 1559
[09 1 3 1598
[10 2 1 1191
[11 2 1 1233
[12 2 1 1221
[13 2 2 1860
[14 2 2 1910
[15 2 2 1926
[16 2 3 2492
[17 2 3 2527
[18 2 3 2511
[19 3 1 1226
[20 3 1 1202
[21 3 1 1180
[22 3 2 1516
```

```
[23 3 2 1501
[24 3 2 1498
[25 3 3 1801
[26 3 3 1833
[27 3 3 1852
[END DATA.
ANOVA Sales by Display (1,3) Price (1,3).
[Next command's output on page   4
finish
```

Sampling

Q11

Please explain why it is not sufficient to state in Chapter 3, "Random sampling procedures were used for subject selection." In brief, why is a detailed synopsis of sampling methodology needed in a research report?

Test Development

Q12

When you become involved in research it will be necessary to address two separate but common issues: reliability and validity. Please:

1. Identify the meanings and utility of reliability and validity.

2. React to the statement, "A test can be reliable, but not valid."

Levels of Quantitative Description

Q13

A researcher wished to measure the reaction (i.e., opinion) of subjects to a specific phenomenon. An appropriate test was developed and, after exacting work, acceptable estimates of reliability and validity were offered. A Likert-type scale was used to measure reaction: 1 = Low to 5 = High.

Are the data associated with this test: nominal, ordinal, interval, or ratio? Please offer evidence to defend your answer.

Note. Assignment B is based on lecture notes and readings from required texts. Please contact me if you work on this assignment before lectures are given.

COMPUTER-BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT C

Electronic Cluster

January 01 to June 30, 1990

Thomas W. MacFarland, Ed.D.

Nova University

Center for Computer and Information Sciences

Fort Lauderdale, Florida 33314

COMPUTER BASED RESEARCH AND STATISTICS (IS 7100)

ASSIGNMENT C

General Instructions

You are now ready for the Assignment C, the final assignment for IS 7100. Up to this point you have examined research and underlying factors associated with statistical analyses. You will now become directly involved in the "mechanics" of statistical analysis. You may find this assignment exceptionally interesting since statistical analysis can be most challenging. When you attempt the many questions associated with this assignment, please recall that:

1. All questions are found in the required text:

   McClave, James T., and Frank H. Dietrich, II. STATISTICS, 4th edition. San Francisco, California: Dellen Publishing Company, 1988. ISBN 0-02-379260-4

   To understand the complexity of the various statistical analyses, it is necessary to read the entire chapter cognate to each question.

2. Acquaintance with SPSS-X Release 3.0 will be gained by careful review of:

   Norusis, Marija. SPSS-X INTRODUCTORY STATISTICS GUIDE FOR SPSS-X RELEASE 3. Chicago: SPSS, Incorporated, 1988. ISBN 0-918469-54-6

   I will send samples of SPSS-X files as the course progresses. You may also find it helpful to obtain the student version of SPSS. There are obvious differences between STUDENTWARE and SPSS-X, but the basic organization of files is certainly more than slightly similar.

3. All statistical analyses are to based on the following format:

   A. xxx.doc (documentation)

   B. xxx.dat (data)

   C. xxx.r01 (system run)

D. xxx.o01 (output)

E. xxx.con (conclusion)

I will send you examples of files using this format. Otherwise, the following statements will help you prepare Assignment C for submission:

1. Review the entire assignment before you answer any questions.

2. Using the most appropriate means, answer the questions in the form of a file that will be later submitted through esXXX.

3. Give complete answers and document all calculations (i.e., show your work), if necessary.

4. Follow standard practice in use of the English language. It is best to use a "spell check" to be assured of spelling.

5. Review your answers to see that the questions were accurately answered.

6. Submit the assignment through esXXX.

Questions

As previously mentioned, all questions can be found in the required text:

McClave, James T., and Frank H. Dietrich, II. STATISTICS, 4th edition. San Francisco, California: Dellen Publishing Company, 1988. ISBN 0-02-379260-4

And, it is necessary to read the entire chapter cognate to each question.

Questions for Assignment C

Question #	Topic	Page #
2.25	Measures of Central Tendency	040
2.43 (a)	Measures of Variation	055
2.58	Measures of Relative Standing	063
8.21	Student's t-test	422

8.27	Student's t-test	423
8.41	Student's t-test	436
9.19	Oneway ANOVA	502
9.36	Twoway ANOVA	524
9.45	2n Factorial Analysis	542
10.7	Wilcoxon Rank Sums	576
10.20	Wilcoxon Signed Rank Test	585
10.36	Kruskal-Wallis H-Test	595
10.63	Spearman's Rank Correlation Coefficient	618
11.6	Chi-Square, One-Dimensional	643
11.28	Chi-Square, Contingency Table (2x2)	659
11.32	Chi-Square, Contingency Table (4x4)	660
11.40	Chi-Square, Contingency Table (6x2)	666
12.24	Simple Linear Regression	700
12.45	Pearson's Coefficient of Correlation	718
12.70 (a)	Simple Linear Regression	743
13.47	Multiple Regression	833

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Tuckman, Bruce W. CONDUCTING EDUCATIONAL RESEARCH. 2nd edition. New York: Harcourt, Brace, and Jovanovich, Incorporated, 1978. ISBN 0-15-512981-3