These guidelines are from:
Statistics: Learning by Doing by Spurrier, Edwards and Thombs, Whittier Publications (1999).

INTRODUCTION:

Clear, honest, and efficient communication of results is absolutely vital to any research effort. The information you've obtained will be of little use if it is not effectively shared with others. Employers consistently report that communication skills are one of three common deficiencies they see in most technical-major college graduates (the other two are teamwork and statistical skills). This appendix is a set of simple guidelines to help with report writing for the extended writing assignments of *Statistics: Learning by Doing*. Do not stop here in developing your communication skills. Put genuine enthusiasm and energy into continued improvement in both written and oral communication. Take courses in technical writing and public speaking.

From the start, understand that technical report writing is very different in its goals from other writing tasks. The goals of report writing are stated in the first sentence of this appendix: clear, honest, and efficient communication of results. If the report is also pleasant to read, that's wonderful, but it is secondary. Moreover, what makes a report pleasant to read may surprise you: It should be clearly and logically organized, be thorough but not verbose, have neat and completely labeled tables and graphs, and so on. The person reading the report is not doing it for his or her entertainment. It's work. If the report is not clear, if unanswered questions come to the reader's mind, it is hard and annoying work. The report will pleasant to read if it is not hard work to read it.

The report-writing process will vary according to individual tastes, but usually begins with rough outlines, followed by one or more rough drafts, leading to the final report. It is not a good idea to try to accomplish all of this in one sitting; allow some time between refinements for ideas to develop. Read this appendix carefully before you begin, and refer to Appendix 2, "Technical Report Writing Checklist," after each outline or draft refinement. Your instructor also may provide you with a scoring rubric, a form used in grading your report. The rubric shows points allocated to various aspects of the report. If a rubric is provided, you should also refer to it carefully before you begin writing, and as a check of each draft of your report.

In all communication you should strive to know your audience in advance. What do they need from you? What is their background? Will they understand technical terminology? A good basic approach for a technical report aimed at a wide range of professional audiences is **top-down structure**. Under top-down structure, readers get their first look at the experiment in the **title** and an **abstract**, which summarizes the most important experimental findings. Next, a more detailed description of the experiment, data summaries, and interpretations are presented in the body of the report in three separate sections: "**Materials and Methods**," "**Results**," and "**Discussion**." Finally, if the raw data (the ultimate details) are so voluminous as to detract from the body of the report, then it can be placed in an **appendix**. In your reports, we strongly recommend you use these sections as an overall structure. Sections should be clearly labeled with bold section headings, which blank space between sections. Details of the content of each of these sections will be provided in this appendix.

TITLE AND ABSTRACT

The title and abstract are extremely important. You should word them very carefully. Some readers might be extremely busy people who have only a few minutes to look at your report. In a work setting, your immediate supervisor might have time to read it all, but his or her supervisor,

who may be the president of the company, might not. In these times of information overload, a well-written title and abstract can quickly tell a reader the most essential outcomes of the experiment. He or she can then decide rationally whether to put the report down or read further to get more details. Get in the habit of questioning every word you use in the title and abstract. In the revision stage, play the role of a reader who has only five minutes: Will he or she get the "bottom line" results from only the title and abstract?

We suggest you center the title at the top of the first page, followed by the one-paragraph abstract at the middle of this page. At the bottom of this page put the date, author's name(s), and any other necessary information; for example, if some readers may not know the author, a mailing address may be appropriate. Though this page comes first in the report, it should be written last. The report itself has to exist before you can adequately summarize it.

Good abstract writing is an art, unappreciated by most beginning writers. Don't write an abstract designed purely to wet the appetite of the reader. The time for that is not in technical report writing.

It is not possible to provide every detail of the experiment in one paragraph, but a good abstract gives the most important findings, very quickly and in relatively non-technical language.

MATERIALS AND METHODS

This section is meant to tell the reader why the experiment was done, precisely how the data were collected, and what data analyses were done, without telling the results. Do not provide data summaries, graphs, tables, and so on in this section. Those belong in the "Results" section. The "Materials and Methods" section should begin with a clear statement of the purpose of the experiment. Next, a thorough and honest description of the manner in which data were collected should be presented. This description should include details of the use of measuring instruments, operational definitions of basic measurements, randomization schemes, blinding or double-blinding schemes, and so on.

This section should also contain a brief but complete description of data analysis methods, including the types of computer hardware and software used. Be careful to be complete in the description of statistical methods used; simply saying "a two-sample t-test was performed" does not allow the reader to assess the validity of your methods. There are different kinds of two-sample t-tests one could perform, and what were the hypotheses (in words), anyway? Was it a one-sided or two-sided test? You might give references to textbooks that provide explicit formulas, but do not include formulas in the "Materials and Methods" sections. If formulas are really necessary, they belong in an appendix.

The "Materials and Methods" section is very detailed about what work was done, but gives no indication of what results were obtained. The author gives details in turn on experimental design, data collection, and statistical methods. Notice the use of formatted lists to improve readability.

RESULTS

This section presents the experimental results in summaries, mostly tables and graphs, without interpretation. This allows readers to begin to form their own opinions and interpretations before reading yours, which come in the "Discussion" section. If anything unusual happened during data collection, it should be noted early in the "Results" section. The "Results" section should also contain a "road map" paragraph telling the reader where (in what tables and figures" the summary information is displayed. Tables should be numbered Table 1, Table 2, and so on, and

the graphs should be numbered Figure 1, Figure 2, and so on. Use the numbers to refer to tables and figures in the "Discussion" section.

It may seem a simple enough job to present a graph or a table, but often authors get sloppy or lazy and do not title and label graphs adequately. The reader who has only one minute will read the abstract; the reader who has only three minutes will read the abstract and then look at the figures and tables. For this reason, a good rule of thumb is that, if possible, *a figure or table should stand alone as a piece of information*, without requiring reference to the text.

Similar guidelines apply to the presentation of tables. They also should be informatively titled and labeled, including units of measurement. If the raw data can be presented in a table occupying less than half a page, it should be presented in the "Results" section. For non-graphical summaries of data, do not simply cut out computer output and paste it in the report. Usually computer output includes some extra information that can confuse readers and make it hard for them to find the most important summaries. Pick and choose the appropriate summary measures (mean, standard deviation, etc.) from your computer output, and rearrange these measures neatly in a well-labeled table of your own design.

DISCUSSION

In this final section of the report body, honestly interpret the findings of the experiment and give any explanations you may have for patterns in the data. If the findings were inconclusive, or stand in contrast to what was expected in advance, say so. Point out any shortcomings or limitations to your interpretations. For example, in most of our sessions we are not able to truly obtain a random sample of human subjects, and this is a shortcoming. Also present any ideas and suggestions you may have for further experimentation. The scientific method is a cycle of hypothesis, experiment, hypothesis, experiment. Your experiment will usually generate new hypotheses, which you should stat in the "Discussion" section.

APPENDIX

If the raw data are too voluminous to be included in a table of less than half a page, but not more than two or three pages, present it in a well-labeled table in an appendix. Also, if any equations or very technical material needs to be presented as clarification of the statistical methods used, these should be presented in an appendix.