TITLE OF THE PROJECT (all caps)

by

Your Name Here

Submitted in Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

in the
Department of Mathematics and Statistics

Graduate Project Committee

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YOUNGSTOWN STATE UNIVERSITY
May, 2013

ABSTRACT

Type the text of your Abstract here. It should be a one page, concise description of your project. It should be self-contained, and a person should be able to read this one page and get a very good idea about the subject and main results of your project. This section should not contain cross-references to any other paper or book.

ACKNOWLEDGEMENTS

This page is optional. If desired, you may acknowledge those individuals that played a significant role in your successful completion of the project. If you are going to have this page, then you should make sure to include the YSU Department of Mathematics and Statistics, and of course, your project advisor and committee members.

Contents

1 Introduction

The goal in this section is to introduce the reader to the subject of your project. This is the place for relevant background information that a person should know in order to put your project in context. Discuss any prior history or work that has been done on this topic. Define any essential terms or concepts from other fields that are used throughout the paper.

Most of your literature review will be mentioned here. Every time that you reference a paper, be sure to add a citation, for instance, Efron [3]. In order to cite properly, your References section needs to be current, consistent, and complete; see [1] and [2] at the end of this document.

2 Overview

This section gives a bird's eye view of your project, as a whole. You have introduced the reader to all of the necessary background for your project in Section 1, so now (s)he is ready to learn, in broad terms, what you did in your project and how all of the pieces fit together.

It is not appropriate to include many minute details in this section. It is fine to include graphs, but they should only be used in the context of communicating the main ideas of your project. Lengthy tables and lists of variables or p -values are not appropriate; those should be saved for Section 4, Analysis.

It is appropriate to mention the main research questions that you are investigating with this project, but save the answers and details for Sections 4, 5, and 6.

2.1 Project Timeline

This is set apart so that you can see what a subsection looks like inside of a section. The list below is typeset with a Description environment. It describes a basic time-line for you while completing your project.

Beginning of semester or earlier: Schedule meetings with potential advisers to see if they are available to do a project with you. Bring to the meeting ideas of topics/subjects that you would like to study. Prepare a list of the MATH/STAT courses you have had at YSU. Leave the meeting with two or three possibilities of projects for you to investigate. Be prepared to go to the library or Internet to find data related to the topic(s) discussed.

Second meeting: Bring example data sets to the meeting, for discussion and selection. Choose a project adviser and project topic. Ask your adviser about potential professors to serve on your project committee, and then approach the candidates to ask them (politely) if they are willing/able to serve on the committee. Keep searching until you find two professors who accept.

Third meeting: Bring your class schedule, and set up regular weekly meeting times with your adviser. Notify your adviser of the additional committee members. Schedule a tentative date for the computer lab for your project presentation and defense. This will be Presentation Day, and should be scheduled for at least one week prior to the beginning of Final Exams. After the meeting, speak with the other committee members to revise or confirm the presentation day.

Two weeks prior: PROJECT REPORT DUE DATE. Give a final, printed copy of the document to each of your committee members. Begin preparation for your presentation by making PowerPoint slides of your project work. Organize your presentation in the same way that this document is organized.

One week prior: Meet with your adviser to discuss your presentation slides. Rehearse your presentation by yourself, with a clock to time the length of the delivery. Send your adviser an email containing the title of the presentation and an abstract, for announcement to the department faculty.

One day prior: Prepare a notice containing the time, place, and title of your presentation. Make copies and post them in the Math office and on the office suite doors.

Presentation Day: Good luck! Do a great job!

Immediately afterward: Make sure that the projector and other equipment are secured and returned to their original location(s). Remove the notices from the doors. Meet with your adviser to discuss revisions to the document which have been suggested by the committee.

Three days afterward: Give your adviser a printed copy of the final, revised draft of the document for the adviser to review.

After approval: Give a three-ring bound final copy to Sandi, the Mathematics & Statistics Secretary. You may also wish to give your adviser a bound copy.

TO GRADUATE: Very important! If you did not finish your project in one semester, then you recieved a grade of "In Progress" (PR) in the semester in which you registered for your project. In order to graduate, this grade must be changed using special paperwork. You need to go to Sandi, the Mathematics & Statistics secretary, and request a "Change of Grade" form. She will give you instructions for filling out the form. Submit the completed form to your adviser, who will fill in the remaining details. If this form is not completed, you will not graduate. It is your responsibility to make sure that all of the procedures are followed in a timely manner.

3 Methodology

The goal in this section is to lay the theoretical foundation of the later sections. You will be doing a lot of computations in Section 4, and you will want to include here a discussion of each of the main procedures that you will be using. For example, if you are doing a project with multiple regression analysis, then you should discuss the theory of the regression model in this section, together with the model's assumptions. If your project is a cluster analysis of some data, then you should detail the algorithms/methods that were used and their properties and weaknesses.

If you use certain statistics to perform a hypothesis test or assess the accuracy of a particular procedure, then they should be quoted here (with their respective formulas). Again, discuss their strengths and weaknesses, and make it clear why you chose them. If there are any special probability distributions that you are using, then you should include them here, with formulas, and describe their connection to the topic you are studying.

3.1 Mathematical Typesetting

Given that you are a student in the Department of Mathematics & Statistics, the probability is high that you will want to include mathematical notation and formulas in your report, and they are entered using a special LaTeX math mode. There are three primary ways to do this.

The first way is called an "inline formula", which means that the formula is included in the text with everything else. An example would be $f(x)$ or $\int \sin x \, \mathrm{d}x$. This way is handy when mentioning variables or short expressions.

The second way is called a "displayed formula", which is separated from the rest of the text in its own displayed paragraph. An example would be

$$f(x) = \frac{1}{\sqrt{2\pi}} \mathrm{e}^{-\mathrm{x}^2/2}, \quad -\infty < \mathrm{x} < \infty,$$

which is useful for longer formulas or equations.

The last way is a "numbered formula", which displays the formula labeled with a number, for instance,

$$\mathrm{e}^{i\pi} - 1 = 0. \tag{1}$$

There can be many of these in a the document, and the equation numbers will be generated automatically by LyX.

Please note that there are many, many, many things that can be done with LaTeX and mathematics. Do a Google search for "latex math examples" for a taste.

In particular, all variables, functions, and expressions in the document should be written in math mode. It is not acceptable to write X or Y when discussing variables in your report... they should instead be X and Y so that the reader can easily distinguish between mathematics and text.

3.2 Copying Material from the Internet (or elsewhere)

This document is yours, and the reader will assume that all of the words in it were written by you unless something special indicates otherwise. Take, for instance, this quote from Fox [4] which discusses the bootstrapping technique:

> Bootstrapping is a general approach to statistical inference based on building a sampling distribution for a statistic by resampling from the data at hand. The term "bootstrapping," due to Efron [3], is an allusion to the expression "pulling oneself up by one's

> bootstraps" – in this case, using the sample data as a population from which repeated samples are drawn. At first blush, the approach seems circular, but has been shown to be sound.

Notice that the above quotation environment makes it immediately obvious to the reader that the words in the separate paragraph were written by John Fox, and not by me. Any passages that are copy/pasted into this document must be set apart in a quotation environment, just like the one above. If there is even a sentence in the document that you have copied from the Internet (or elsewhere, such as a book or journal) which is not set apart and referenced, then you have committed plagiarism, a very serious offense at this level of your academic career. Be careful about quoting external material.

Rather than copying someone else's writing into your project, it is better to read the material and write another version in your own words. Try to paraphrase the material into a shorter version that makes sense to you, or alternatively go in the other direction by adding explanations that the original author skipped. The goal is to make the passage your own.

There are exceptions: mathematical definitions, being one. These are quoted everywhere and are contained in many texts and references. It is not necessary to quote/reference a definition, unless the specific definition warrants otherwise. Ask your adviser concerning any cases about which you are unsure.

4 Analysis

This section is the "meat" of the project. It is here that you present your computations, tables, scatterplots, diagnostic graphs, and p-values. You will spend the majority of the time working on the results to put into this section. It is appropriate to include

1. The source of the data set, including its size, the number of variables, the types of the variables, and the format in which you received/collected the data.
2. Summary descriptive statistics of the data. For quantitative variables, address the center, spread, shape, and unusual features of the data distribution. Graphical displays include boxplots, histograms, scatterplots, etc. Identify outliers. For categorical data, summary frequency distributions and bar charts or dotplots are appropriate.
3. A discussion of the model fitting, or the other major purpose of your project. List all assumptions being made.
4. Diagnostic checks of your fitted model. Does the model fit well? Are the assumptions satisfied? Employ remedial measures if necessary, and repeat.
5. A practical application of your fitted model or procedure, something useful, the main goal of your project. Assess the adequacy of your model with a measure of model performance.

Do not spare any details for the reader in this section. If (s)he has a question about a statement made elsewhere in the paper, (s)he will come here to sift through the results for an answer. If the answer is not buried here, then the validity of your paper will be compromised.

4.1 Graphs and Displays

The Analysis section will likely have many graphs and displays. Here are some general considerations to keep in mind:

- Every graph should be labeled "Figure", with a respective figure number, and an accompanying descriptive title. If you are using LyX to typeset your document, then every figure should be enclosed in a "Figure float", in which case these labels will be generated automatically.
- Every graph or display should be referenced in the main body of the text, and should have at least a paragraph describing what the figure is and the figure's salient features. If you can't come up with even a paragraph of important things to say about the picture, then the picture is not worth including in the project report.
- Every graph should be a maximum of 1/2 page in size, except in very rare circumstances[1]. In addition, try to avoid putting two (2) graphs on one (1) page; rather, put the graphs on two separate pages and include a description underneath of each one. See the previous bullet.

An example of a properly labeled graph is included as Figure 1 (but the paragraph is missing).

[1]Some graphs are simply too big to fit in 1/2 page and still be legible without a magnifying glass. As of 2013, I have only encountered two (2) graphs in graduate projects which I have supervised that merited their own page.

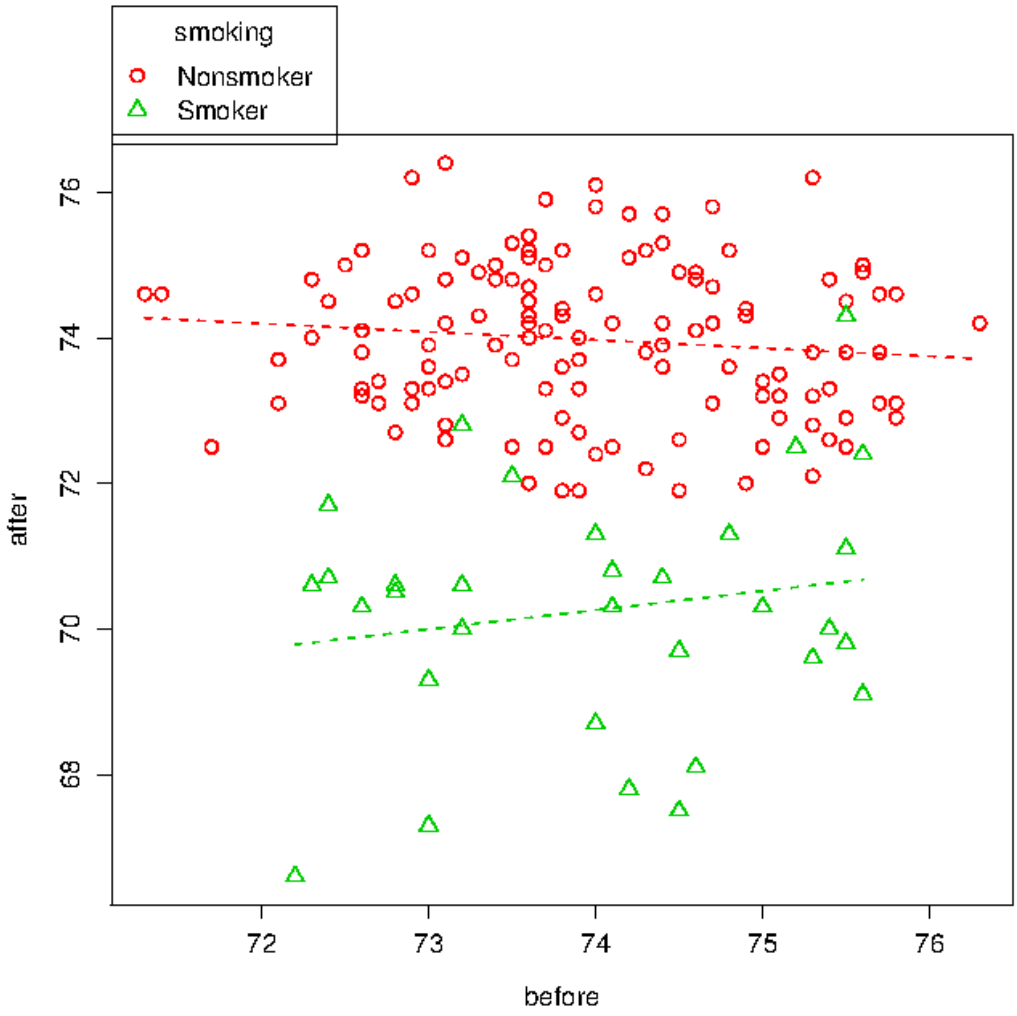

Figure 1: Scatterplot of `after` vs. `before` by smoking status.

4.2 Tables

DO NOT COPY/PASTE TABLES FROM SPSS®. The tables returned by most software packages are overly complicated and are full of irrelevant information. If you have a generated table that you would like to include, take a close look at it and identify the essential information that you need to convey your point. Next, retype (or export) that information in a table, properly referenced, in the main body of the document. An example of a good table is included below as Table 1. Note that it has been enclosed in a table float, which is analogous to a figure float.

Note that there has been a deliberate attempt to use dividing lines sparingly in the table. Try not to put too many lines; they end up making your table more difficult to read.

The previous remarks made about figures also apply to tables.

- Every table should be labeled and numbered, with a descriptive title.
- Every table should be referenced in the main body of the text with a corresponding descriptive

Table 1: Tabular results of *Ethnicity* versus *Gender*.

		Gender		
		Female	Male	Total
Ethnicity	Caucasian	15	4	19
	African American	31	7	38
	Asian/Pacific Islander	8	1	9
	Hispanic	16	1	17
	Other	4	3	7
Total		74	16	90

paragraph, at least.

- Avoid especially large tables, if possible. Some tables may be safely relocated to the Appendix.

5 Discussion

In Section 4 you included many tables, graphs, displays, and calculations. In the Discussion section, the goal is to make sense of the results presented in the Analysis. Take a step back from the details and try to address: "What are the data telling us?" Try to put the results in context, and discuss the implications of the results that you found.

It is appropriate in this section to admit problems that you faced with the data, and limitations to your study. If the data do not support your original hypothesis, then say so. It is better to admit weaknesses of your study up front, rather than try to conceal them and hope that no one notices, or even worse, to ignore the weaknesses entirely. Spending time thinking critically and reflectively about the results will strengthen the project overall.

6 Conclusion

This is it! The Conclusion section is the end of the road, the location to which all other sections are pointed. Think of this section as an expanded and less concise version of your ABSTRACT. The reader should be able to read the Conclusion and have a complete picture of the main questions which led you to this project, and the answers that you found.

A Supporting Documentation

Every project is unique. However, in nearly every project there is additional information which supplements the discussion in the main narrative but whose inclusion would clutter the paper needlessly. Place this extra material here. It could include additional graphs, lengthy tables, background mathematical theory, etc.

B Complete R and SAS® Scripts

You should collect all of the computer code that you used at any point in your project and post it in this section. There will certainly need to be some cleanup of the code to make it legible to the reader, but do not delete too much. The reader should be able to take the code from your project and repeat the analysis, verbatim. It is a good idea to make a final test-run of the code in this section to make sure that there aren't any crucial steps missing.

Remember: all computer code/listings should be in a monowidth font (such as Courier) and not in a proportional font (such as Times Roman). For instance, you should write `summary()` instead of summary().

About this document: (the below was typeset in the `verse` environment)

Last modified: April 17, 2013
Author: G. Jay Kerns, Ph.D.
Typeset with: Org mode `8.0pre` in GNU Emacs `24.3.5.1`
Electronic versions in (`.org`, `.lyx,=,` `.tex`, `.pdf`)
formats can be downloaded from GitHub

References

[1] THE FORMAT OF THE REFERENCES MUST BE CONSISTENT.

[2] DO NOT COPY/PASTE REFERENCES FROM THE INTERNET. They will almost surely be in a different format. Take thirty seconds and translate the reference into a format consistent with the others.

[3] Bradley Efron. Bootstrap methods: Another look at the jackknife. *Annals of Statistics*, 7:1–26, 1972.

[4] John Fox. *An R and S Plus Companion to Applied Regression.* Sage, 2002.